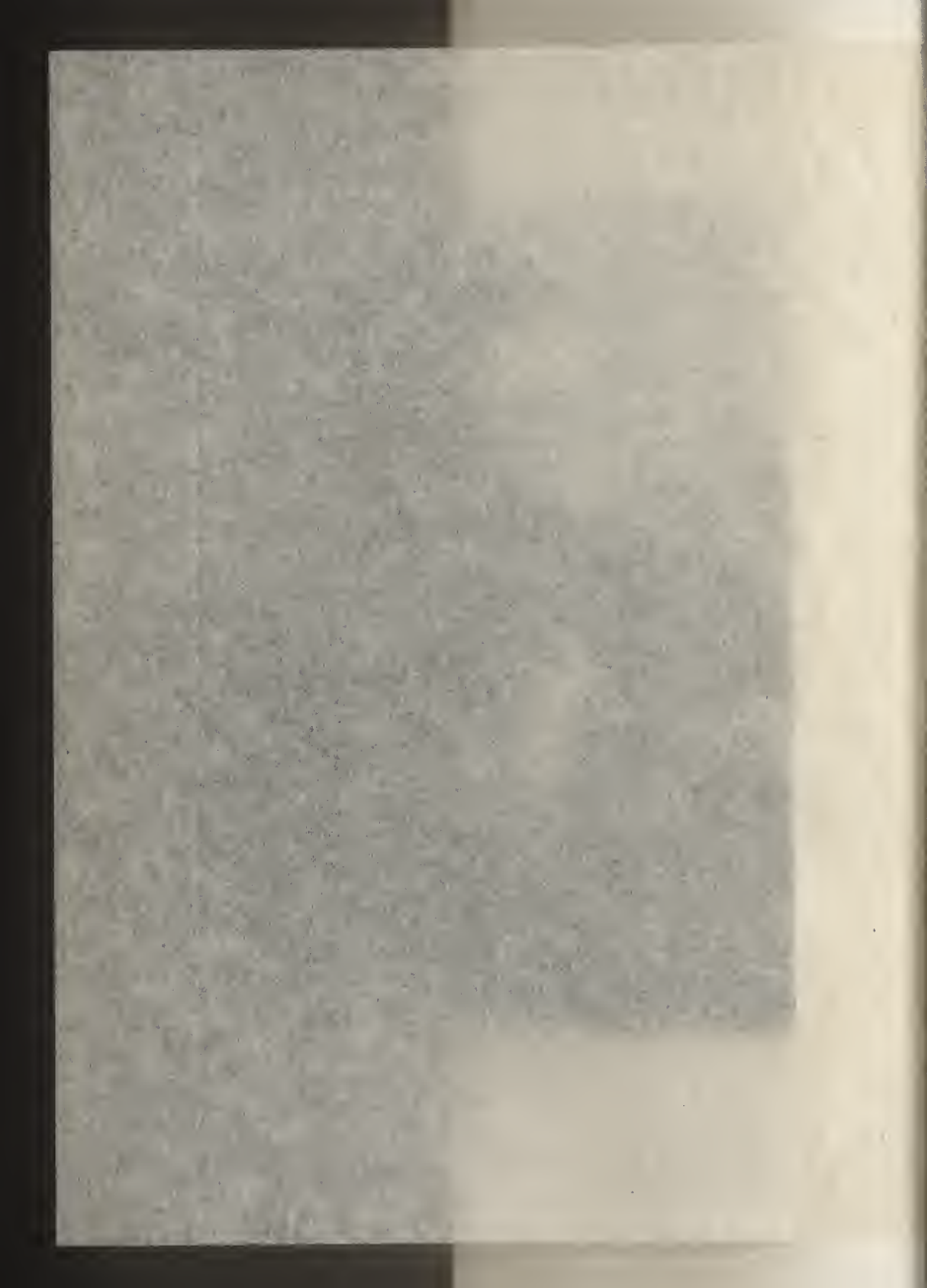
# THE MECHANISM OF THE LINOTYPE

BY JOHN S. THOMPSON

OTTMAR MERGENTHALER.

(From a photograph taken in 1894.)



# THE MECHANISM OF THE LINOTYPE.

A COMPLETE AND PRACTICAL TREATISE ON THE INSTALLATION, OPERATION AND CARE OF THE LINOTYPE, FOR THE NOVICE AS WELL AS THE EXPERIENCED OPERATOR.



By JOHN S. THOMPSON.

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With Full Information Concerning the New Two-letter Machines, Not to be Found in Any Work Heretofore Published.

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# PREFACE.

THE subject-matter of this book was first published serially in THE INLAND PRINTER under the title of "The Machinist and the Operator." The many assurances of the great help which the series afforded have induced the publishers to produce it in its present form under a new title. The entire work has been revised and amended so as to include the latest improvements added to the machine, and new chapters incorporated dealing in detail with the two-letter attachment and estimates of the cost of installing the machine. Covering the field more fully and thoroughly than any works now before the public, it is believed the book will be found of inestimable value. It is presented in the hope that it will meet with a hearty welcome by those wishing to perfect themselves in this most important branch of the graphic arts.

# A BRIEF SKETCH OF THE INVENTOR.

OTTMAR MERGENTHALER, inventor of the Linotype, was born in Württemberg, Germany, May 10, 1854, and died October 28, 1899. He learned the trade of watch and clock making, emigrating to America in 1872, securing employment in the electrical instrument works of a relative in Washington, D. C., later moving to Baltimore, Maryland, when the shop was removed to the latter place.

It was while developing a process of typewriting to do away with typesetting, and perfecting a machine for this purpose for a customer, that Mr. Mergenthaler's inventive faculties were first directed to the end he afterward achieved with such distinction. The first scheme attempted was to produce by typewriting a print just like that produced from printer's type, and to multiply the work so made by lithographing. The system failed. The process was then changed and a machine constructed which impressed characters into papier-maché, and lines of type were cast by the stereotype process from the matrix so made. This proving impracticable, the attempt was abandoned in 1879.

In 1883 Mr. Mergenthaler conceived the idea of assembling metallic female matrices and casting molten metal into them to form a type line in the same machine. An experimental machine proved the idea feasible. In this machine the matrix letters were stamped into upright bands, each carrying a full alphabet, figures, points, etc., and the line was composed by allowing the bands to descend until they were caught at the proper elevation by stops, previously set up by operating the keyboard. The line was justified by the operator striking the space key until a pointer indicated that the line was filled

completely; the line was then cast. A new company was formed in which Mr. Mergenthaler secured an interest, and new life was injected into the enterprise.

In 1885 a syndicate of newspaper men, composed of Whitelaw Reid, of the New York *Tribune;* W. N. Haldeman, of the Louisville *Courier-Journal;* Victor Lawson and M. E. Stone, of the Chicago *News;* Henry Smith, of the Chicago *Inter Ocean;* W. H. Rand, of Rand, McNally & Co., Chicago, and Stilson Hutchins, of the Washington *Post,* bought a controlling interest in the company, paying therefor the sum of $300,000.

The shortcomings of the band-matrix machine were in a great measure overcome when, in 1885, Mr. Mergenthaler developed the independent-matrix machine, in which corrections could be made as the matrices were assembled, the line being automatically justified by the wedge space. The first machine used commercially was in the office of the New York *Tribune,* where it was used on the daily paper and also on a large book, "The Tribune Book of Open-air Sports," which was the first book composed by the new method of setting type. Machines of this pattern were subsequently installed in the offices of the Chicago *News,* Louisville *Courier-Journal,* Washington *Post* and Providence *Journal,* all non-union offices.

The company's factory was removed to Brooklyn in 1888, Mr. Mergenthaler starting an independent factory of his own in Baltimore. In 1890 he brought out a new style of Linotype, which was a vast improvement over the machines then in use. Its appearance was also entirely changed. The perpendicular, separate channels containing the matrices were displaced by an inclined magazine in one piece, the air-blast eliminated, new locking-up and casting mechanism introduced — the entire machine substantially resembling the Linotype of the present day, with the exception of the base, which was a massive, square affair. The Brooklyn *Standard-Union* received the first machines of this pattern and was the first office to employ members of the typographical union to operate them. The New Orleans *Times-Democrat* and a number of other Southern and Eastern papers now installed machines, and the success of the Linotype was assured.

Improvements were being continually made, the symmetrical column base, the light-acting keyboard, spring justification and noiseless clutch being the most important. The two-letter matrix and universal mold are the most recent improvements, permitting italics, small-caps. and black-letter running in the text to be produced without any change of matrices or loss of time, and changes of length and thickness of slug to be accomplished with one mold. Many of these later improvements are the work of other inventors, though to Mr. Mergenthaler belongs the honor of producing the machine itself.

In 1894, in order to avoid litigation over the wedge space-band, Mr. Mergenthaler devised the "step-justification" machine, of which pattern 225 machines were built, but after the purchase of the patent covering the double-wedge space by the Linotype Company for the sum of $416,000, the manufacture of this pattern of machine was discontinued.

Broken in health, Mr. Mergenthaler shortly after retired from active participation in the work of perfecting the Linotype, his death occurring in 1899.

About six thousand machines are now in use in the United States, the royalty to the inventor and his heirs being $50 on each machine built.

Besides the factory in Brooklyn, New York, factories in Toronto, Canada; Manchester, England, and Berlin, Germany, are engaged in the manufacture of the Linotype, which are in use in almost every country.

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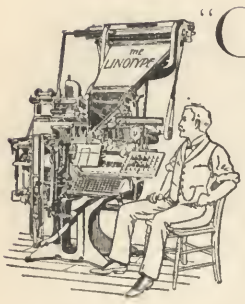
# THE MECHANISM OF THE LINOTYPE.

## CHAPTER I.

### OILING AND WIPING THE MACHINE.




"OF course, you have often been told that an operator never could become a Linotype machinist," said the Machinist to the Operator, "but I entertain a different opinion on that subject. Now, as you are to be my helper, I'll endeavor to teach you what I know about this machine, and if you apply yourself, by the end of a year you will be able to handle a Linotype as well as any one, or I'll miss my guess."

The new machinist had just taken charge, and while the plant was not an old one, the machines were not in the best of shape. He proposed to break in one of the operators to help him.

"This whole plant needs a thorough cleaning," continued the Machinist, "so if you'll get into your fighting togs, get that long-spout oil can and a bunch

of waste, I'll show you the first rudiments of the business — how to oil and wipe a machine.

"This oil cup standing above and behind the mold disk, which oils the mold-disk bearing (see Fig. 21), and the one behind the driving pulley, and the cup at the other end of the driving shaft (see Fig. 16), should receive attention twice a week. Oil moderately once a week in all the other oil holes and cups. Commence by oiling the two bearings of the short shaft which turn the mold disk (see Fig. 22); then the two bearings of the shorter one close to the metal pot; the six holes in the pump lever and bracket and the one in the pump-lever roller (see Fig. 20); then oil the pot lever and roller bearings (see Fig. 23); the one oil cup on the ejector and mold slide; the two holes in each of the justification-lever roller bearings under the cams; the roller bearings of the first elevator lever which rests on the large cam outside of the machine frame (No. 1); the roller bearings of the second-elevator lever which rests on cam No. 6; the two holes in distributor-shifter lever bearing, and a drop on the surface of the cam for same (No. 3); then the oil cup on end of cam shaft.

"Now around to the back of the machine and oil the four holes in that lower shaft and the four holes in the shaft just above it, on which the first elevator, the ejector lever, and the first and second justification levers swing; a drop of oil in the holes in each justification lever above the spring rods; then the two holes in bearings of the upper shaft on which the second elevator is mounted; the two oil cups on either end of the driving shaft, previously mentioned, and the cup

on the inner side of the loose pulley. You'll have to throw off the belt to get at this one. A little oil on the mold-cam lever rollers (see Fig. 20), and a drop on the pot-retracting cam on the other side of the gear cam (No. 9). Now the bearings of the two rollers you can see just above the driving pulley and inside of the machine frame — the line-delivery carriage and spaceband shifter-lever rollers; the oil holes in each of those three short shaft bearings you see through the square hole in the frame of the machine; the oil cup on this end of the cam shaft and the two oil cups on the intermediate shaft driven by the belt from the main machine pulley; the cup back of the intermediate clutch; a drop in each of the front and back keyboard-roller bearings. And now around to the front of the machine and put a drop in each of the bearings on the other end of keyboard rollers; then oil this end of each of the three short shafts you oiled from the rear. Put a drop of oil in the oil holes in the intermediate clutch pulley and the matrix-belt pulley just above it, and in the two holes in the plate behind lower matrix-belt pulley. Raise the assembler block and put a drop in the bearing of assembler-wheel shaft (see Fig. 14). Spread a little oil on the slides of the first elevator.

"Now lower the vise and oil this hole in the bracket at end of vise-jaw closing screw; oil the four bearings of the justification rods and the automatic dog or sliding pin (*C*, Fig. 18); the pin and roller of line-shifting lever; a drop on the locking pins for the mold disk.

"Close up the vise and climb up and oil the distributor (see Fig. 30). A drop in each of the tubes at

either end of back screw (the one nearest to you), and the three holes in the bracket on the front screws at left-hand end and two holes on right-hand end; also cup over distributor clutch and one hole in the trip-lever below the clutch. Oil the distributor-shifter slideway and put a drop on that small cam on end of the back distributor screw (the matrix-lift cam), and on the pivot of the lift lever, and the job is complete.

"There are a few other oil holes which I'll show you now," continued the Machinist, "but they don't need oil except at long intervals. Slip the belt off the distributor clutch pulley and raise the belt. If you turn the pulley around now you will see a screw-head and the word 'oil' stamped near it. Remove the screw and put a drop of oil in the hole occasionally. The roller bearings of the assembler slide (see Fig. 13) and the bearings of assembling-elevator lever on the keyboard need a drop now and then. The upper guide for the second elevator — that block into which the elevator seats itself beneath distributor-shifter guide — should have a little oil rubbed over its surface. The pawl on ejector lever can be oiled occasionally. The keyboard pulleys also have oil holes. Always follow the oil can with a bunch of waste and wipe off all surplus oil and the dust which may have accumulated. Other patterns of machines, of course, have other oil holes to accommodate changes of parts.

"Now with a clean piece of cloth or waste wipe out the assembler, the line-delivery channel, elevator jaws, mold face and vise jaws, removing any metal adhering to these latter surfaces; the intermediate spaceband channel, distributor box and distributor shifter buffer

— in fact, all points touched by the matrices (except the magazine) when circulating through the machine. Now go around to the back and, while the machine is running, wipe the surfaces of all the cams. Any dust or grit on their surfaces cuts them down if not removed. When through with that, spread a little oil over the inside surface of the second cam (the one with the segments on it). A block on the short shaft alongside the metal-pot (see Fig. 22) slides over this surface, and a little oil will prevent undue wear.

"Here is a polishing compound with which you can clean the nickeled parts and brighten the surfaces of the magazines. This won't make the machines run any better, but it adds to the appearance of the plant and shows that the machines are taken care of. Some day I'll get a bottle of brass lacquer and put a coat of it on the surface of the magazines and they will stay bright and will not tarnish after that.

"You can now go over the other machines the same way. You won't need to stop the operators more than a few minutes at a time, and by the time that job is finished I guess it will be time to wash up."

"There must be nearly a hundred places to be oiled on each machine," said the Operator, in a tone of apprehension.

"Sixty-eight holes and eleven cups," answered the Machinist, "besides the several bearings and surfaces I showed you. It hadn't ought to bother an operator to remember a few things like that."

## CHAPTER II.

### THE CAMS AND THEIR ACTION.

"TO gain a complete knowledge of the mechanism of the Linotype," said the Machinist one day, "it is first necessary that you should understand the functions of the cams which control the movements of the machine and upon which its operations are dependent. The assembling and distributing mechanisms alone are independent of the main cams, they being driven by a belt connected directly to the machine driving pulley. The cams, however, are the 'brains' of the machine, and we'll first take up the study of them.

"Starting from the large cam outside the frame of the machine, we will call this cam No. 1. It is the first-elevator cam, which lowers the matrix line to the casting position, aligns it, elevates it to the point of transferrence, and then returns the elevator to its first position. The small roller resting on the surface of this cam is connected with the first-elevator lever, which reaches through the circular base of the machine, and is attached to the bottom of the first-elevator by a short link.

"Cam No. 2, just inside the machine frame, is the mold-turning cam. The toothed plates attached to it

impart rotation to a short shaft carrying a beveled gear, which in turn is geared to the mold-turning shaft that carries the pinion which turns the mold disk (see Fig. 22). The short plate (*A*) is first to engage the beveled gear, which turns the mold one-fourth of a revolution, bringing it into casting position. The longer plate (*B*) next engages the gear and turns the

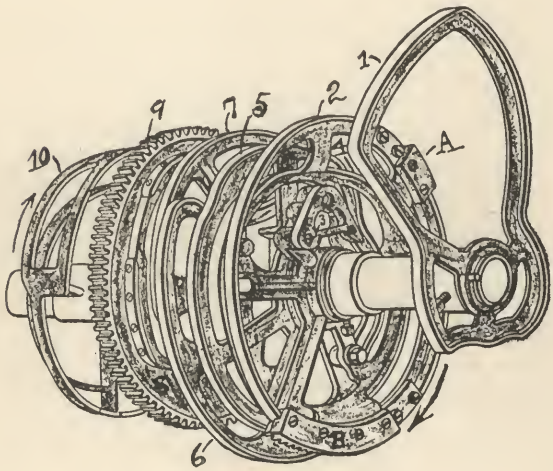



FIG. 1.

mold the remaining three-fourths of the revolution, past the base-trimming knife to ejecting point. Steadiness and precision in the sudden stopping of the mold disk is secured by a square block attached to the bevel-gear pinion, which block slides over the inner surface of this cam.

"Cam 3 is attached to cam 2, and is the distributor-

shifter cam, which, at each revolution of the cams, engages a projection attached to the distributor shifter and shifts the line of matrices from the second elevator into the distributor box.

"Cam 4 is the second-justification cam. The justification lever, directly under this cam, carries a roller which rides on the surface of the cam. This lever, which is forked at its front end, also operates the vise-closing screw.

"Cam 5 is the first-justification cam, which, like the second-justification cam, operates its lever to justify the line of matrices.

"Cam 6 is the second elevator cam. The roller resting on its surface follows its contour and lowers the second elevator to receive the matrix line, raising it then to the distributor.

"Cam 7 is the pump cam, a roller on the pump lever following its surface and operating the pump to cast the line.

"Cam 8 is the pot cam, its function being to lock the pot firmly against the mold disk before the line is cast. A roller carried by the pot lever is the medium through which this pressure is exerted at the proper point.

"Cam 9 is the driving gear and mold cam. The gear meshes with a pinion (*C*, Fig. 16) on a shaft directly underneath, driven by the driving pulley of the machine. The left-hand side of this gear wheel is channeled out to form a cam in which a roller (1, Fig. 20) operates to advance the mold disk and lock it up against the assembled line of matrices and, after the line is cast, to withdraw the mold, again advancing it

before ejectment of the slug and withdrawing it after slug is ejected. This gear wheel also carries on its right-hand side, near the periphery, a small lug, called the pot-retracting cam, because it retracts the pot after the line has been cast. Another block on the left-hand side of the same gear wheel engages the pawl on the ejector lever and carries it forward, ejecting the line from the mold.

"Cam 10 is the most interesting cam of all. It is the line-delivery and elevator-transfer cam, acting also to retract the ejector lever after slug is ejected from mold. This cam carries the automatic safety and stopping pawls and controls the movements of the line-delivery carriage and the transferring of the matrix line from the first to the second elevator and the shifting of the spacebands into the spaceband box. It really consists of two cams in one, the larger or outer cam controlling the return of the line-delivery carriage and the smaller or inner one causing the movements of the line-transfer mechanism.

" If you will look between this cam and the machine frame just in front of the cam-shaft bearing, you will see two small rollers mounted on short arms or levers. The one farthest to the front connects by shaft and lever with the line-delivery carriage. You notice this roller stands about three inches away from the larger cam. When a line of matrices is elevated, a latch is released by the assembling elevator, the line being carried to the left by one of those heavy coil springs you see in the hollow frame of the machine. As the line moves to the left toward the first elevator, the cam roller approaches its cam until, when the line of

matrices is fairly within the elevator jaws, the roller strikes against the stopping pawl carried by this cam. The stopping pawl is knocked to the right, out of engagement with the stop lever (*b*, Fig. 17) on which it rested, the friction clutch is released and the cams revolve. Now, the shape of this cam causes the roller to return to its original position, where the line-delivery carriage is caught by its latch and held there. The cams revolve beyond this point, and the stopping pawl again coming in contact with the clutch throw-off, the machine comes to a stop.

"The second cam roller has followed the contour of the smaller cam during the revolution of the machine and has caused the matrix line to be transferred from the first to the second elevator at the proper time."

"What is that second pawl on the larger cam for?" asked the Operator.

"That is a safety pawl and its purpose is to cause the machine to stop by striking the stop lever, just as the stopping pawl does, whenever anything occurs to prevent the second elevator coming down into position to receive the matrix line from the first elevator or whenever the shifter mechanism is caught so as to prevent the cam roller following the surface of the cam. If the roller *does* follow the surface of the cam, you will notice that it pushes the safety pawl to the right and prevents its coming in contact with the stop lever. The second coil spring in the hollow frame holds the roller normally against the cam."

"You said something about the spacebands being shifted by this cam. How is that accomplished?" the Operator asked.

"The shifting of the spacebands is an auxiliary movement to the transferring of the matrix line. The lever which is connected with the transfer mechanism is connected also by a link to the spaceband-shifter lever, so that the motion of the former in transferring the line advances the spaceband shifter, and when the transfer mechanism returns to its original position it causes the spaceband shifter to retreat also, the shifter hook carrying the spacebands with it to the spaceband box."

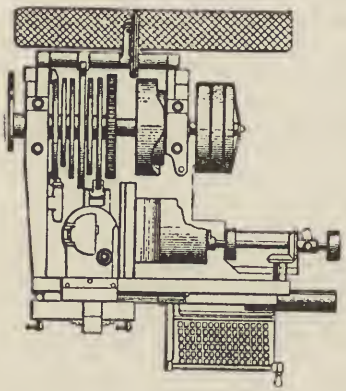


FIG. 2.

"How does this cam retract the ejector?" was the next question.

"In this way," returned the Machinist; "the right-hand side of the larger or outer cam is so shaped that it engages a projecting lug on the ejector lever, and carries the latter with it as it revolves, withdrawing it from the mold. This cam also unlocks the safety hook which holds the second elevator in an elevated position."

"Is there any danger of the cams slipping out of their position and causing a smash-up?" asked the Operator.

"No, no danger of that," the Machinist replied, "though I've known the last cam, No. 10, to become loose and slip to the right. All the other cams inside

the machine frame are bolted together and can not slip, while all the cams are keyed so it is impossible for them to change their position except sidewise. The slipping of the cam No. 10 would be evident by the failure of the line-delivery carriage and spaceband transfer to return far enough to act properly. It's easy enough to slip the cam back, should this occur, and make it fast by the set-screw.

"When you understand thoroughly the action of the various cams," continued the Machinist, "you will have a fairly good insight into the mechanism of the Linotype. Watch and study them while the machine is running. Their consecutive and simultaneous movements you should be familiar with, so I have made out a list that you can study at your leisure."

The list he handed the Operator was as follows:

The assembled line of matrices is raised in the assembler and taken between the fingers of the line-delivery carriage, which is released and carried to the left into the first elevator. This movement causes the driving clutch to be thrown into action, the cams revolving in a direction toward the front of the machine. The resulting movements are:

1. Mold disk revolves one-quarter of a revolution, carrying the mold from ejecting into casting position.

2. First elevator descends with matrix line to position in front of mold, first justification lever also descending a trifle to actuate slug lever.

3. The mold disk moves forward toward matrices, leaving .010 of an inch space between the vise jaws and matrices and face of mold.

4. Vise-closing lever rises, allowing the vise-clos-

ing screw to move left-hand vise jaw to the limit of the line being cast.

5. First-justification lever rises, causing spacebands to be driven upward through line successively, and also operating the slug lever.

6. First-justification lever descends, relieving the spacebands from upward pressure.

7. Vise-closing lever descends, moving the vise-closing screw and slightly relieving the matrix line from pressure, to allow alignment of matrices.

8. First elevator rises 1-32 of an inch, lifting the matrices, so their lower ears are aligned against the upper shoulder of groove in mold, causing vertical alignment.

9. The pot advances, pushing the mold forward against the matrices, causing their alignment face-wise.

10. The pot recedes, relieving the matrix line from pressure of the mold.

11. Vise-closing lever rises, allowing the left-hand vise jaw to move so as to finally limit the length of the matrix line.

12. First and second justification levers rise simultaneously, pushing spacebands upward to complete justification.

During actions 3 to 12 the line-delivery carriage returns to its normal position, and is now ready to receive another line of matrices from assembler. The line will be held waiting in line-delivery channel until the first elevator is ready to receive it.

13. The pot locks up against the mold, forcing the mold forward against the matrix line.

14. The pump acts and metal is forced into the mold cell to form a slug.

15. Metal-pot and mold disk retreat, withdrawing face of slug from matrices, the upward pressure on first elevator being relieved simultaneously.

16. Justification and vise-closing levers descend.

17. The mold disk stops and pot is retracted, separating mouthpiece of pot from base of slug.

18. The mold disk revolves through three-quarters of a revolution, carrying the slug past the base-trimming knife, trimming the slug to height and presenting the slug in a vertical position in front of two trimming knives. During this action the first elevator rises and the second elevator descends to the intermediate channel.

19. The transfer carriage now transfers the line from the first to the second elevator, moving back to allow the second elevator to rise and lift the matrices out of intermediate channel, the spacebands remaining behind, while the mold disk moves forward on to the locking pins and ejector advances to eject slug from mold.

20. The transfer carriage and spaceband lever now approach, pushing the spacebands under the spaceband pawl, the ejector blade advancing and forcing the slug from mold between the front trimming knives to the slug receiver in front.

21. First elevator descends to normal position and second elevator rises, conveying matrices to distributor box, the distributor shifter moving outward to be in readiness to shift matrices into the distributor box.

22. Spaceband shifter and transfer levers retreat,

conveying the spacebands to the spaceband box, the distributor shifter feeding matrix line into distributor.

23. Ejector and mold retreat to normal position, the justification lever rising slightly to actuate slug lever, pushing slugs to the left.

The machine has now made a complete revolution.

## CHAPTER III.

### THE CARE OF MATRICES AND SPACEBANDS.

"WHAT is the best thing to clean spacebands with?" asked the Operator one day. "The machinist who worked here before you came used to clean them with coal oil. Is that a good plan?"

"Yes, that's all right once in a while," answered the Machinist, "to wash them in coal oil, but I'm a firm believer in the graphite theory, and my experience is that there's nothing so good as graphite — provided you use the proper kind. There are some grades that are the worst thing possible to use. There is a special brand made by the Dixon Crucible Company for type-setting machines which I always get. It comes high, but it's cheap in the long run.

"I have some of it here in this tin can," continued the Machinist, "and if you'll take the bands out of that idle machine over there I'll show you how I clean them — which, however, will be your work hereafter.

"Do you see that discolored spot on the sleeve (Fig. 3)? The cast occurs at that point on the space-band and if that discoloration is not removed, metal will eventually adhere to the sleeve and then when the wedges are driven up in the act of justifying a line of matrices, the lumps of metal on the spaces crush in the walls of the matrices next to them. It will take but a

few hours' time with spaces in that condition to ruin a whole set of matrices.

"Now, I first rub that spot on the sleeve on a board to remove the stain, being careful to hold the band perfectly flat to avoid rounding the edge, and then polish the whole band with graphite sprinkled over a piece of felt tacked on a board. This makes them so slick that the wedges slide up and down freely, and when you get a number of them in a line the justification springs will be able to drive them up without any trouble. The graphite also prevents the adhesion of metal at the casting point.

FIG. 3.

"Take the spacebands out of each machine every morning before the operators begin and clean them in this way. Be careful when replacing them in the spaceband box to turn the sleeves to the right. This is most important, as the wedges can not be driven up freely if the bands are turned the wrong way in the machine and the result will be metal will enter between the matrices when casting and the slugs will show 'hair-lines' when printed from.

"I'll set the automatic pump-stop lever so the machines will not allow a short line to be cast, and then if the matrices show 'hair-lines' in the

print you will be held responsible, and you'll lose your yellow jacket — savvy?"

"How do you set that short-line lever?" asked the Operator.

"First of all, we'll take off all these vise-jaw closing springs," replied the Machinist. "They're bad things to use in connection with a pump stop, and the company doesn't apply them to machines now being built.

"This pump stop (*H*, Fig. 4) is pivoted at its elbow ($d^3$) and is operated by the justification lever (*J*). If this lever rises to its extreme limit it should strike against and raise the end of the pump-stop lever (*h'*) so as to cause its upper end to slip beneath the small block (*h*) on the pump lever (*E*), and thus prevent the plunger descending and casting the line. The adjustment is made by the screw (*h'*) against which the justification lever strikes. Loosen this screw first; then disconnect the pump plunger to avoid accidents and pull out the starting lever and let the machine turn over until it nearly reaches the casting point, when stop

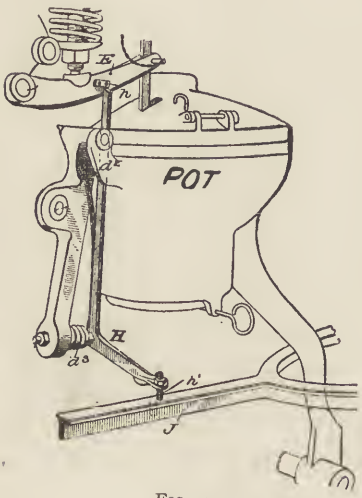



FIG. 4.

it. The vise jaw is open, of course, and the lever (*J*) is up to its full stroke. Now screw down the adjusting screw (*h'*) until the upper end of the pump stop passes beneath the block (*h*) on the pump lever. Tighten the jam-nut on the adjusting screw and leave it alone ever after.

"Now a line with spacebands in it and enough matrices to prevent the spacebands being driven to their utmost capacity will not allow the justification lever to rise high enough to trip up the pump stop; but if the line does not contain enough matrices, the lever will rise to its limit, driven by the justification spring, the pump stop will be actuated, and no cast will occur.

"If the pump-stop were not set so as to prevent a loose line casting, the metal would enter between the matrices and show as 'fins' in the print.

"The new pattern of pump stop is operated by the right-hand vise jaw. A compound lever is mounted on the machine frame above the mold slide, one end of the lever standing below a block on the inner side of the pump lever, the other end of the pump-stop lever reaching to the front of the machine and lying just behind the right-hand vise jaw, which has a little play. The pump lever in this pattern is always locked except when a line of matrices containing enough spacebands to spread it far enough to move the right-hand vise jaw is sent in to be cast. The leverage of the pump stop is such that a very slight movement of the vise-jaw withdraws the other end of the lever from beneath the block on the pump lever and permits the line to be cast. Of course, if the line is not full enough, the jaw will not be moved and no cast will occur. There is an

adjustment on this style of pump stop on the lever behind the vise jaw. The way to set this is to send in a full line of matrices and spacebands and when the spacebands are up to their full stroke turn the adjusting screw so that the block on the pump stop is just cleared by the end of the lever. A short line then will not cast."

"How often should the matrices be cleaned?" asked the Operator. "I suppose they get dirty and greasy after a time."

"Well, that depends a great deal on the way the matrices are handled by the operators or any one else who may have dirty or greasy hands. Then, too, unless the path of the matrices through the machine is kept clean and free from oil the matrices will become foul. It is oftener the magazine that needs cleaning than the matrices. Dust settles in the magazine and sometimes, though it should be guarded against, free graphite is carried into the channels. If the matrices are run out and the magazine brushed out, first dry, then with a brush dampened with gasoline, and then when dry polished with graphite sprinkled on the brush, paying particular attention to the top plate of the magazine, the mats. will slide all right and never need more than a rub of their ears on a board to clean them. If, however, oil is allowed to get on the matrices they will have to be washed in gasoline, though they should always be polished in graphite after so doing. If the matrices are old, washing them will probably make them show 'hair-lines.' When the walls of the matrix get crushed in a little the dirt on the sides will gradually fill up the depressions so the

'fins' won't show. Of course, washing the matrices would clean this all out, and the result would be what this office won't stand for —'hair lines.'

"Right here, however, I want to warn you that whenever a matrix or two fails to respond it is not an infallible sign that the matrices need cleaning. Nine cases out of ten it is the mouth of the magazine that is befouled. To clean this, insert the round rod in that hole drilled in the right-hand side of the magazine a couple of inches above the lower end (1, Fig. 29), and shove the rod through to the other side of magazine. Then run out the two matrices in each channel which remain below this stop-rod. You can then lower the flexible front guide by unlatching the large front glass and depressing the flexible front until it is disengaged from beneath the magazine mouth. Those four hinged escapement covers can then be raised and the escapements and the magazine mouth thoroughly cleaned. The new pattern of magazine has the escapement cover in one piece, with locks on each end. You will find this plan much more effective and quicker than brushing out the magazine, or cleaning the matrices whenever the latter refuse to respond to the touch of the key. These escapements should be examined in every instance after brushing out the magazine, as bristles from the brush frequently get caught in the escapements and bind them so they can not move. Touch the keys and notice their action while the covers are raised."

## CHAPTER IV.

### THE AUTOMATIC GAS GOVERNORS.

"I NOTICE we don't have hot and cold metal any more," remarked the Operator to the Machinist. "That was the bane of our lives formerly. What did you do to prevent it?"

"Well, in the first place," the Machinist replied, "I found that the governor on the main pipe wasn't acting at all. The float in it was weighted down so that whenever the pressure in the main fluctuated, the heat under the pot varied likewise, which variation the governor is intended to prevent.

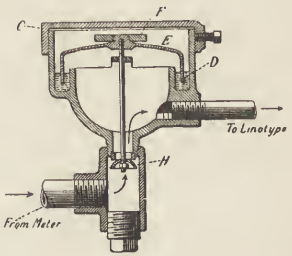


FIG. 5.

"Here is a sectional diagram of the governor (Fig. 5), which is a simple affair, but evidently little understood by some. The gas from the main enters the governor and flows in the direction indicated by the arrows. A float *E* has its rim *D* immersed in mercury, a rod extending downward from the float connecting it with the valve *H*. The pressure of the gas tends to raise the float *E* and

thus close the aperture at *H*. To overcome this tendency a sufficient weight *F* is placed on the float to admit a moderate flow of gas. The mercury acts as a flexible seal around the rim *D* of the float and prevents the escape of gas. Should the pressure in the main fall off, the float sinks deeper into the mercury and the opening at *H* is enlarged thereby to admit a larger volume of gas. When the pressure increases, the float rises and partly closes the opening at *H*. Obviously, if a heavy weight is placed at *F* the float can not respond to the varying pressures, and the result will be hot and cold metal. When replacing the cover *C* care must be taken to prevent its interference with the movement of the float."

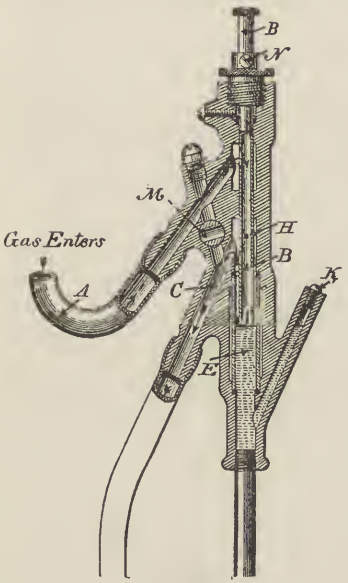


FIG. 6.

"Does the machine governor act on the same principle?" the Operator questioned.

"No," replied the Machinist; "its action depends entirely on the temperature of the metal in the pot. I have here a diagram of the gas governors which are attached to these machines. This is the way this governor works: The gas from the supply pipe enters

the tube *A* (Fig. 6) and flows upward through an opening near the upper end of the iron tube *B*. Descending through this central tube, the gas escapes from its lower end between the tube and the surface of the mercury *E*, and then passes up around the tube *B* and downward through the tube *C* to the burners under the metal-pot. That part marked *M* is a valve which, when turned, opens a by-pass directly between the tubes *A* and *C*. The governors formerly applied to machines did not have this by-pass, but are alike in all other particulars. By means of that valve and by-pass a full head of gas can be sent to the burners without disturbing any adjustments in case of cold metal or when heating up in the morning.

" The mercury is contained in the tube and a holder which extends under the mouth of the metal-pot. When the temperature of the metal increases, the column of mercury expands and its surface rises toward the opening in the lower end of the tube *B*, thus reducing the space through which the gas passes and diminishing the flow of gas to the burners. When the metal in the pot cools, the column of mercury contracts, the opening between it and the bottom of the tube is enlarged, and more gas flows to the burners. The reason the gas doesn't go out completely when the mercury entirely closes the opening in the bottom of the tube *B* is because there is a small pinhole higher up in the tube at *H*, which allows enough gas to flow to the burners to keep them lighted.

" When the metal-pot is cold the mercury should be in view in the lower part of the glass tube. When the metal in the pot reaches the proper temperature, the

surface of the mercury should just touch the lower end of the tube *B*. The proper temperature is about 540 degrees for new metal; old metal requires less heat — between 520 and 525 degrees. The tube *B* can be lowered by loosening the screw *N*. The latest style of governor does not have the adjustable tube *B*, but has a solid plunger which is adjustable, and can be lowered into the mercury, which it thus displaces and causes the mercury to rise and close the aperture as much as is desired. This type of governor also has a pressure indicator mounted on top of it.

"When the adjustment is once made, the temperature will be automatically regulated, and the tube should not be moved unless from leakage or oxidization there is a loss of mercury, when the screw *K* can be taken out and mercury added, after which the tube *B* should be properly readjusted to height. The mercury should be emptied from the governor periodically and the dirt and oxides removed."

"How can you tell when the metal is at the proper temperature without a thermometer?" asked the Operator.

"You've noticed me fold up a strip of paper and plunge it into the metal, haven't you?" replied the Machinist. "Well, if the paper turns a dark brown, it's too hot. The paper will turn a light brown at the edges when metal is at the proper temperature. Lowering or raising the adjustable tube *B* the thickness of a sheet of paper will alter the temperature several degrees."

## CHAPTER V.

### HOW TO MAKE CHANGES.

THE Operator had frequently seen the machines changed, and had assisted in this work, but was not quite confident of his ability to make a change in the absence of the Machinist, so one day he asked him to explain how the thing should be done.

"You know, of course," said the Machinist, "that all our molds in this plant are fixed as to the size of body they will cast, but are adjustable in length. The company is now making a new universal mold, capable of adjustment to cast any length of line up to thirty ems of any size from ruby to pica. We have here two-mold disks, or, in other words, a separate mold for each size of type we use. There are four-mold disks in use in some offices, but the new universal mold takes the place of nine adjustable molds, so book-offices nowadays are ordering nothing but the universal mold. In the latter mold, the upper portion or cap is movable, and to change from one size of body to another it is only necessary to remove both end liners and insert ones of the proper thickness, the liners being held in place by three screws in the rim of the disk, which can be tightened down on the movable cap.

"I have to change this machine from 24-em brevier

to 20-em nonpareil," continued the Machinist, "so if you will pay attention I'll explain how it is done.

"The controlling lever to the left of the keyboard must be pushed back and the vise lowered. Back the machine a little by pushing against the first-elevator cam (No. 1), far enough to allow the ejector lever to be pushed forward by its handle which stands above the cams of the machine. When the ejector lever is pressed forward it causes the ejector blade to project through the mold (Fig. 7). If the blade does not

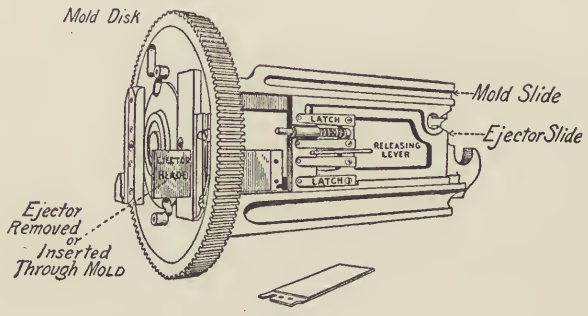



FIG. 7.

advance easily, turn the mold disk slightly while pressing forward on the ejector lever. The ejector should project only about an inch beyond the mold face. Now reach your right hand in alongside the mold slide and grasp the releasing lever and draw it to you. The ejector can now be withdrawn.

"As we are changing from a large to a smaller slug, the 20-em nonpareil ejector can now be inserted through the mold. Press the ejector firmly into its seat, holding meanwhile the releasing lever with your

right hand, restoring the lever when the blade is in position. You can now bring the machine into original position by pulling out the controlling lever.

"To change the liner in a mold, remove the split or cotter pin which holds the mold pinion (*H*, Fig. 22) in place. Slide the pinion forward far enough to clear the pin on the flange. Now by turning the pinion you can revolve the mold disk and bring the mold to be changed into a position midway between the pinion and the casting position of the mold. This is the most convenient point to get at the mold screw (*A*, Fig. 8),

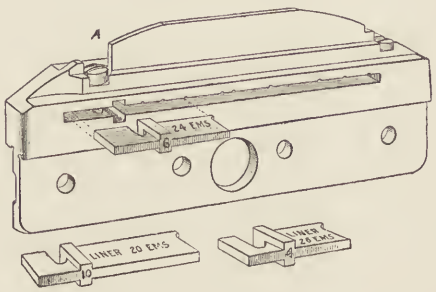



Fig. 8.

which must now be loosened, when the liner can easily be pushed out of the mold from the rear."

"This liner seems to stick pretty tightly," said the Operator. "Shall I drive it out?"

"Yes, but be careful how you do it," cautioned the Machinist. "Get a piece of old brass rule and then drive close to the shoulder of the liner. If you drive against the end of the liner you will be liable to spring it.

"When substituting the liner desired, see that you

get it perfectly flush with the mold face. Now tighten the screw (*A*) again, revolve the mold until the one desired is in ejecting position (Fig. 7), when the pinion will slide back into place and you can restore the cotter pin. There is a punch-mark on the gear of the mold disk and also on the pinion. These marks will match if the mold is in proper position.

"That 20-em liner you gave me to put in the mold was marked 10. Was that all right?" asked the Operator.

"Sure thing," the Machinist replied. "This is a 30-em mold and a No. 10 liner will cast a 20-em line. Some of these machines are equipped with 24-em molds, however, so a liner marked 10 will in these molds cast only a 14-em line. The liners are marked in the ems of their length, measured from shoulder to end.

"If we had been changing from a small to a larger slug, the larger ejector blade could not have been inserted until the mold had been changed. In any case, consider whether the ejector can be removed after mold is changed or whether it must be done first. In some cases, as when changing from a short, thick slug to a longer and thinner one, or vice versa, the ejector must be removed first, the mold changed, and the proper ejector then inserted. In other cases the ejector need not be changed at all, as a brevier blade will do for temporary use in ejecting a long primer line, and it is never necessary to use ejectors for every em length of line; a 16-em ejector will work perfectly with a 17-em line. The even numbers in ejectors are all that are needed.

"The new universal mold disk has a long, narrow slot cut through it so that ejector blades may be removed and inserted through this slot when it is turned into proper position.

"In case it is desired to use the second mold in the disk and the liner does not need to be changed, nor the ejector, it is unnecessary to lower the vise. Slip the cotter pin out and the pinion can be slid forward far enough to allow the disk to be revolved to bring the desired mold into proper position.

"We must now change the position of the vise jaw to conform to the change in length of slug," said the Machinist. "The arrangement for this purpose now being placed on all new machines is a great improvement over the old method, and I have ordered the necessary parts and will attach the new device to all these machines. The principle of it is shown in this drawing. (Fig. 9). The left-hand vise jaw *A* rests against the end of a rod *C*, which is graduated to half-

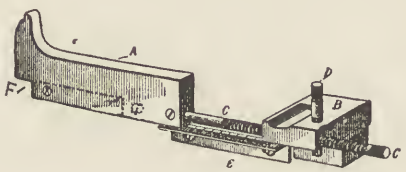



Fig. 9.

ems. This rod is supported by the block *B* and held in position by the corrugated pin *D*. To change the length of the face on the slug it is only necessary to remove the pin *D*, slide the rod *C* to the position desired, as indicated by the em-scale *E* directly under-

neath the rod, and replace the pin. Not having this attachment on these machines at present, it is necessary to take out the screw in the vise-closing screw plate, replacing it after turning the square-headed screw until the vise jaw is in the required position. Some machinists have blocks cut to various lengths in ems, and instead of turning the vise-jaw closing screw when changing length of line, they slip these blocks between end of screw and the vise jaw.

"With these machines it is necessary to press down the pin under elevator head and close the vise jaw before making an attempt to turn the vise-jaw closing screw in a direction to make the slug shorter. Otherwise the rack pawl on the vise jaw will be broken or bent. I always take out these pins and rack pawls, as the pump stop has remedied the evil they were intended to prevent. You won't find them on machines now being built, either.

"The next thing to change," continued the Machinist, "is the spaceband driver. That's the block which drives up the spaces to justify the lines. Lift it off and replace it with one of a length that will come inside the hollowed-out corner of the vise jaw (*F*, Fig 9). In the older type of machine these blocks were fastened in place by screws from beneath."

"Does this have to be changed for every em change in length of line?" asked the Operator.

"No," replied the Machinist. "A spaceband driver will justify lines varying three ems in length. For instance, a 13-em driver will justify a twelve, thirteen and fourteen em line. The latest improvement in vise jaws, however, obviates the necessity of changing

spaceband drivers at all. The jaw is cut away underneath, as shown by the dotted lines in the drawing (Fig. 9), so that a 30-em driver is all that is required for any line ranging from thirteen to thirty ems in length, or, with a 24-em mold, a 24-em driver will justify all lines from seven ems up, a range of seventeen ems in either case. Notice that one side of the spaceband driver is beveled, the other straight. The beveled side goes toward you.

"Now close up the vise and change the position of the flexible finger in the first elevator. That semicircular plate in the first elevator contains a coiled spring attached to a small gear which meshes with a rack on the flexible finger. Loosen the two small screws which hold this plate in place and withdraw the plate until the gear slips out of mesh with the rack. The flexible finger can now be slid to a position to allow a space the length of the slug to remain between the ends of the finger and the pawls of the elevator jaws, and then replace the gear-plate and screws. A recent improvement in this arrangement makes the flexible finger in one piece and does away with the rack and pinion, the finger being held in place by a clamping screw.

"We are now ready to change the slug-trimming knives.

"This is an easy operation," said the Machinist, "but it's not always so easy to adjust the knives if they don't happen to trim the slug just right. To change the position of the knives it is only necessary to loosen the screws (1, 2, Fig. 10), withdraw the catch (*B*), move the lever (*A*) until the catch (*B*) is opposite the

proper notch, and then slightly tighten the screws (1, 2) again, meanwhile depressing the lever (*A*).

"Cast a slug now and caliper it with the micrometer on the end ribs of the slug, top and bottom. If all four measurements are not alike the knives must be adjusted until they are."

"This slug is thicker at the top than at the bottom," said the Operator. "How is that remedied?"

"That's on account of the back or left-hand knife not touching the slug," said the Machinist. "It should trim off any overhanging projection but not cut into the slug itself. Slightly slacken those two screws (3, 4, Fig. 10) and remove the slug-receiver or pan and loosen the two screws which hold the back knife. Be cautious which screws you loosen here. The extreme top and bottom ones are the screws you want. The other two hold the mold-disk locking pins in place. Now press the knife nearer to the right-hand knife, tighten the screws which hold it and try another slug."

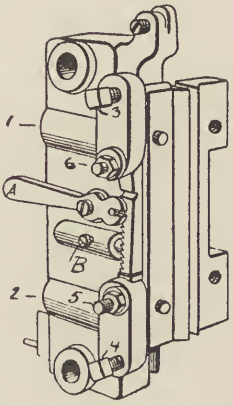


FIG. 10.

"Now it's thicker on the lower end than on the upper," said the Operator, after calipering.

"What does the upper rib measure?" asked the Machinist.

"Eighty-four thousandths," replied the Operator.

"That's just right," returned the Machinist.

"This is a 6-point slug. A point in Linotype measure is .014 of an inch. The lower end is too thick. Loosen the screws (1, 2) again and slacken the jam-nut on the adjusting screw (5) and turn the screw in slightly. Tighten the jam-nut and bring the screws (1, 2) to a bearing and try another slug."

This slug showed upon measurement that the screw 5 had been moved in too far, so it was slackened a trifle, the screws 1, 2 loosened and tightened again, and the next slug came out true.

"The next change is in the assembler," said the Machinist. "Loosen the block on the assembler slide over which the bell-hammer trips. With the screw-driver loosen the screw on the rod which connects the long and short fingers of line-delivery carriage. Now move the assembler finger to the proper position as indicated by the em-scale on the assembler gate, move the block on the assembler slide as far as it will go to the left and make it fast, and then tighten the screw to confine the long finger in its position against the assembler finger.

"Don't forget to restore the assembler finger and slide to its original position, the finger against star wheel.

"We're all ready now to change the magazine."

Changing the magazine was the Operator's long suit, though ever since the day he inadvertently placed the verge lock below the shoulder on the back pawl and caused a shower of matrices when the keyrods were withdrawn, he was in fear of its recurrence each time the magazine was changed. This was his opportunity for enlightenment.

"The reason those matrices fell from the magazine that day," said the Machinist in reply to his question, "is best explained by this drawing (Fig. 11). The matrix-escapement mechanism consists of two vertical catches or pawls, *L* and *K*, which project through the under side of the magazine and engage the ears of the matrices and detain them in escaping until the proper time. The pawls are seated in a rocker or verge *I*, which is pivoted in its center, and thus when one pawl is raised the other is lowered. The spring *N'* gives the verge a tendency to raise the pawl *K* and thus lower the pawl *L*. This tendency is, however, overcome by the keyrod *M*, which hooks into the verge and holds it in its normal position, as shown in the drawing.

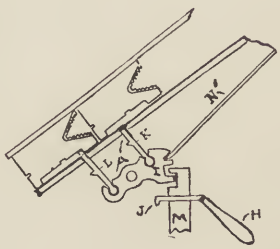


FIG. 11.

"The operation of the keyboard causes the keyrod to rise, the verge rocks upward and the lower matrix is released and falls from the magazine, the other matrices in the channel being detained by the pawl *K*, until the keyrod in descending retracts the upper pawl and allows the matrices to slide further down the channel, the pawl *L* now stopping them.

"You inserted the locking rod *below* the lug on the pawl *K*, so there was nothing to prevent the pawl being raised by the verge spring *N'* the moment the keyrods were retracted in disconnecting the magazine. The lower row of matrices were, of course, released,

and dropped out in a bunch. If you had forgotten to lock the keyboard before withdrawing the keyrods you would have had a time of it. The keyrods will drop down in such a case and their hooked ends will catch on the upper keyrod guide when an attempt is made to put the keyboard lock in place. They have to be raised one at a time and the job is certainly a trying one. On the machines now being made, accidents of this kind are provided against by cutting a groove in the back edge of the keyrods and having a strip fastened beneath the keyrod guide which is seated in this groove and prevents the rods from dropping if the lock should not be put in the keyboard.

"When an accident like that which occurred to you happens again," continued the Machinist, "go right ahead and remove the magazine, place it bottom side up on the bench, and with a short piece of brass rule or something of the kind, raise the verges, a few at a time, inserting the locking rod as you proceed.

"The verge-locking rod must be placed in the opening *A* between the lug on the pawl *K* and the magazine. When the keyboard-locking rod is inserted in the opening between the two keyboard rollers it prevents the keyboard cams and keyrods from dropping when the latter are disengaged from the verges. The small latch *J* which holds the keyrods in their engagement with the verges is now raised, and the keyrods are withdrawn by depressing the lever *H*. Unlatch the large front glass and depress the flexible front until it slips from beneath the magazine mouth, when it will drop forward and be supported by the short chain attached to it from the rear.

"You needn't put that stick in the entrance of the magazine hereafter," said the Machinist. "If you don't tilt that end lower than the mouth of the magazine when changing there is no danger of matrices sliding out. Besides, a splinter of wood might get into the channels and give all kinds of trouble. Tighten the thumb-nut on the spring on left-hand side of the magazine, however, to keep the back entrance closed. The new magazines have a stop which prevents the back entrance from being opened until the stop is pressed out of the way, and so does not require the thumb-nut (see Fig. 29).

"Now set the font distinguisher in the distributor box to prevent wrong fonts getting into magazine, and as the magazine is now disconnected, we'll lift it out."

"Isn't there some rule to follow in setting the font distinguisher?" asked the Operator. "I never know till I've sent in a line whether I've got it right or not."

"Certainly there is," responded the Machinist. "Turn the stud-nut in the distributor box (7, Fig. 28) to the left when changing to smaller type; to the right for larger. One turn for each size of type. You can feel a click at each complete turn of the stud-nut. As we're changing from brevier to nonpareil, make two turns to the left, toward the magazine.

"Always raise the lower end of the magazine first before withdrawing it to make a change, and when putting in another one hold the front end elevated until the upper end is firmly seated under the distributor. If you lower it before then it is liable to catch the matrix lift in the distributor-box and break it. Now loosen the thumb-nut on the side of the magazine

and make the connections. In doing this, reverse the movements made in disconnecting — that is, first replace the flexible front and be sure that it is seated snugly; second, lift the latch *J* and raise the lever *H* to connect the keyrods to the verges, and see that the latch catches to prevent rods slipping back; third, remove keyboard lock, and fourth, the verge lock.

"The final act in changing the machine is to remove the side-sorts tray and replace it with one containing the size corresponding with the font in use. It's a good plan to have the magazines and trays plainly labeled with the size of matrices they contain, and I'm going to fix up a rack to hold the extra trays so the side-sorts won't get pied and lost."

## CHAPTER VI.

### THE MATRIX-RELEASING MECHANISM.

"YOU remember I told you that the assembling and distributing mechanisms are independent of the main cams," said the Machinist to the Operator, "so you see nearly all this machinery is devoted to either operating the casting apparatus or in transferring the matrix line to and from it. The assembling mechanism involves but a small portion of the machine, while the distributor is simplicity itself.

"As the first step in the production of a Linotype slug consists in assembling a line of matrices and spaces, I'll thresh out that portion of the machine first with you. Fig. 12 is a side elevation of the releasing and escapement mechanism. The key levers all extend to the rear of the keyboard, terminating as shown at 1. The key lever *A* is pivoted so that when a key is struck the upright bar *B* is raised, which tilts the end 3 of the rocker or trigger *C* upward, the trigger being pivoted at *C'*. This is the position shown in the drawing. The cam yoke, pivoted at *D'*, normally rests on the point 5, the rocking of the trigger allowing it to drop and its cam *D* to fall on the revolving rubber roller *E*, causing the cam to rotate. The latter, which struck the roller at point 4, has, on account of its eccentric shape, elevated the cam yoke when point 7 is reached in its

revolution, and it now touches the end of the keyrod *G* at point 6, allowing the verge *I* to raise and the matrix to escape from the magazine.

"I explained this escapement mechanism to you once before, when telling you how to lock the verges

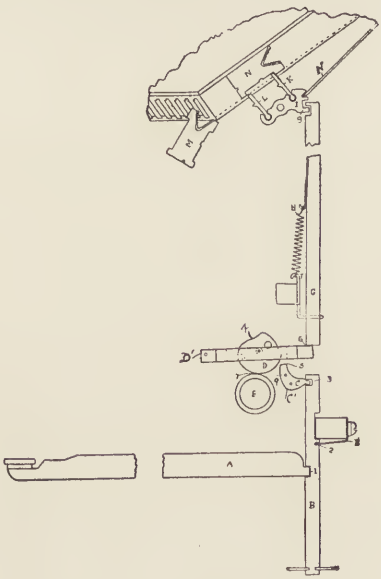


Fig. 12.

when changing the magazine," continued the Machinist, "so I won't go over that ground again. The matrix now being released, the parts restore themselves to normal position. The upright bar *B* is restored by means of the comb-spring *F*, which intersects the bar at 2. This draws the trigger *C* beneath the cam yoke once more, the roller *E* meanwhile turn-

ing the cam *D* and lowering the yoke, which now rests on the trigger at point 5, further rotation of the cam being prevented by a tooth in a plate immediately above the cam which strikes a cross-bar in the cam itself, the depression 4 now clearing the roller *E*. The lowering of the cam yoke permits the keyrod *G* to be restored by the spring *H* connected to the frame *r*. This causes the verge *I* to be actuated, the matrix *N* now taking the position vacated by the matrix *M* (Fig. 12).

"You understand this drawing shows only the front keyboard cams and mechanism. The back cams are a duplicate of these, the idea of alternating the escapement — one cam on the back roller, the next on the front roller, and so on, being merely to give more room to the mechanism. This arrangement thus places the cams of the top row of keys on the back roller, those in the second row on the front roller, the third row on the back, and so on.

"Either front or back sets of cams can be taken out in their frames by removing the large tap screw in each end of the supporting frame. This frame carries the cams, triggers and the rubber roller. Before removing this part of the machine, be sure that the keyrods are connected to the verges and that the locking rods are *not* in. If a wire rod is run through the holes 9 in the triggers and cam frame, before replacing the frame, they will be held rigidly and will cause less trouble while doing so. Any individual cam can be removed without taking out the whole frame by withdrawing the wire which acts as a pivot through the end of cam yokes at *D'*.

"Some operators insist on having the comb-springs

*F* removed so as to make the "touch" of the keys lighter, but I prefer to keep them on, as without them the least dirt or rust will prevent the rod *B* returning after a key is struck, and the cam will rotate and matrices will continue to drop until the trigger *C* is restored. These comb-springs break off occasionally, and when they do I cut off a tooth from an extra strip, loosen the screw that holds the plate, and slip the new one underneath. The new machines have the upright bars *B* weighted, so comb-springs are not necessary with them.

"The rubber rollers *E* must be removed occasionally and their surface washed — preferably in soapy water — and afterward roughened slightly with a piece of sandpaper or coarse emery cloth. This makes the cams bite the rollers and prevents their slipping. Whenever the rubber becomes hard and glazed new ones must be slipped on the shafts. The roller is removed by loosening the small screw in the journal near the pulleys of the rollers, but when replacing the rollers take care that the oil-hole in the bushing aligns with the oil-hole in the journal."

"When a matrix refuses to respond to the touch of the key, where should the trouble be looked for?" queried the Operator.

"There are a number of causes for failure of matrices to respond," the Machinist said, in reply. "In the first place, the cam yoke may not drop, owing to its end 6 being gummy. A squirt of gasoline will usually remedy this. Or, the cam *D* may not revolve when it drops on the roller *E*, owing to the surface of the roller being slick or because the cam pivot is dry and does

not allow the cam to revolve freely in its supporting yoke. In this case, the cam frame should be removed, the cams taken out and a drop of clock oil applied to the pivots with a broom straw or wire. Great care is necessary in this work and only clock oil used. The free end 6 of the yokes should be cleaned and polished at the same time. This should not be necessary oftener than once in eight or ten months.

" Sometimes a matrix or other object falls in on the cams and prevents their revolving. If the keyrod *G* rises and falls when the key is depressed, you may be sure these parts are working all right. If the keyrod remains elevated, something is binding the rod or verge; the verge spring *N'* may have slipped out of place. If all these parts are in working order, however, the trouble is in the magazine. A bent or battered matrix, or one lying flat in the channels, or foul matrices or magazine will prevent matrix responding. If the matrix starts out of magazine a trifle and sticks there, it will usually be found to be binding on the flexible guides. There is an adjustment for these guides resting on the right-hand side of the magazine — a screw and jam-nut — which moves the guides so they can be positioned so as not to interfere with the escapement of matrices. Generally, though, it is better to bend the offending guide out of the way, as the others may be all right. If the matrix refuses to drop while the escapement works freely, the matrix is probably bent or the mouth of magazine needs cleaning. If the matrix hook is used to remove matrices from a channel, depress the key to operate the pawls and allow the matrix-shaped end to pass over them."

## CHAPTER VII.

### THE ASSEMBLER.

"IN order to prevent transpositions of matrices and spacebands, 'squabbling' of matrix lines, etc., the assembler adjustments must be carefully maintained," said the Machinist one day to the Operator. "The assembler chute spring (*A*, Fig. 13) should be bent so as to allow the space of about the thickness of the cap. W between it and the rail (*C*). Just above this point it should be curved so as to tend to throw the bottom of the matrix toward the assembler wheel. The point of the chute spring should be inclined slightly above the horizontal (2), as otherwise it interferes with the delivery of matrices and causes the spaceband to beat the last matrix of a word into the assembler by the top of the matrix striking on the points of the chute spring and causing it to be retarded long enough for the spaceband to transpose. The tongue in the lower end of the chute should be bent so as to deliver the spaceband behind the center of the assembler star. The catch spring (*E*) is intended to prevent matrices falling back to the right while assembling, though if the spring is missing altogether the assembler will probably work just as well."

"What causes the line to 'jigger,' as it sometimes does while being assembled?" asked the Operator.

"To understand that, I'll have to explain this brake arrangement (*G*) on the assembler slide," replied the Machinist. "Notice that this brake clutches the slide on opposite corners, at top and bottom (3, 4), being

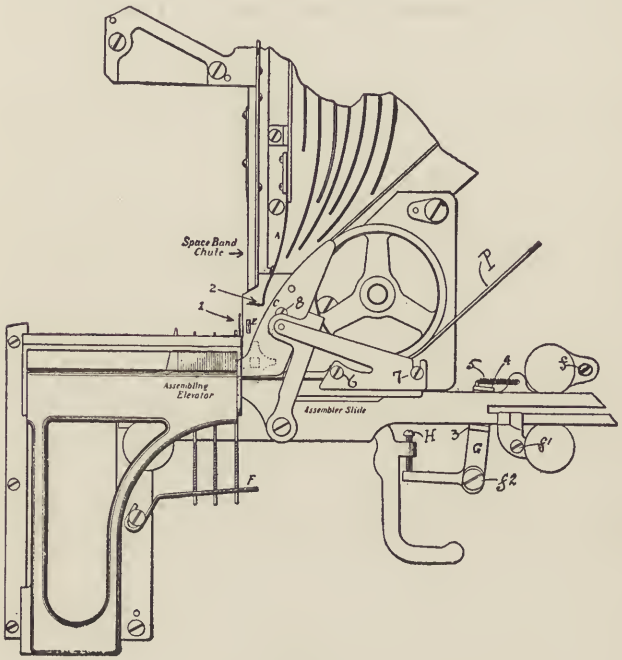



FIG. 13.

drawn into this position by the steel spring (5). The adjusting screw (*H*) standing above the lever extending to the left regulates the amount of pressure the clutch can exercise on the assembler slide. If it is screwed down too far, the clutch becomes inoperative,

and each matrix as it assembles causes the slide to jump violently to the left. If not screwed down far enough, the slide will not return when assembler is elevated. The clutch is released when the line is elevated by the corner (*G*, Fig. 31) lifting the end of the lever on which the screw (*H*, Fig. 13) is mounted, and the long spring on the end of the assembler slide draws the slide back into position.

"Of course, those corners (3, 4) wear in time, and a patch must be fitted in. These corners should be kept square and the brake free from oil. The three screws (*f*, $f^1$, $f^2$, Fig. 13) when removed allow the whole device to be taken off."

"What is that spring (*F*) under the assembling elevator for?" questioned the Operator.

"That's a buffer spring, and is intended to protect the ears of the spacebands by causing the lower end to strike this buffer and thus relieve the ears from the shock of impact with the assembling elevator rails. It should be inclined upward enough to accomplish this."

"How often is it necessary to put in a new assembler star?" asked the Operator.

"Whenever the points become so worn they do not push the matrices inside the hooks on the assembler rails. To renew an old star wheel, you need only take out the two screws (6, 7) which hold the assembler-glass spring and bracket, raise the assembling elevator a little and remove the parts, and take off the front assembler chute rail (*C*). The old star can be drawn off its shaft and the new one fitted on. The square hole will usually need filing out, but don't make it loose on the shaft.

"The fiber assembler chute rails (*C*) also need replacing when worn. It is important in putting these parts together again to see that nothing binds or interferes with the revolution of the assembler star.

"The assembler star," continued the Machinist, "is driven by a friction disk and spring, which permits the star to slip when anything binds it. This disk and spring wear and get so weak that the least friction stops the star. To renew these parts, remove the two screws (9, 10, Fig. 14) in the assembler plate and the whole arrangement can be removed and the assembler belt slipped off the upper pulley. The nut (*K*) can be taken off and the spring or the friction disk renewed. It should not be made so tight, however, as to prevent the slipping of the friction when occasion demands. The matrix catch spring (*E*, Fig. 13) can only be attended to while this part is off the machine.

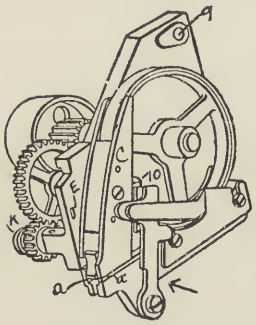


FIG. 14.

"These two assembler strips (*a*, *a'*, Fig. 14) should be kept flush with the ends of the rails (*C*). There is a screw under the bracket which binds these strips, and it can be loosened and the strips removed and their ends squared up. A good deal of experimenting has been done with this part of the assembling device, so if you happen across machines without assembler strips, or with steel ones in place of fiber, or with steel assembler rails faced with flat springs, you'll know it's part

of the development of the machine. The assembling elevator is raised a trifle higher in some machines than in others, and the matrix detaining plates on the assembler, which fit close against the assembler strips (*a*, *a'*), are shaped differently in different machines; their purpose is, however, in all cases, to prevent thin matrices slipping in between the elevator and the bracket, and the assembler strips should come close against the plates. These plates must be renewed occasionally. You can get at them, also, when the assembling device (Fig. 14) is removed.

"The steel rails in the assembler on which the matrices strike when assembling become worn in time and cause the matrices to tip to the right, especially if the hooks on the top rails of the assembler are also worn. It is a neat job to insert a patch in the rails on the old machines, but the new ones have a removable section here which can be taken out and renewed.

"Whenever the matrix driving belt (*P*, Fig. 13) stretches and becomes so loose as to allow matrices, especially capital letters, to slide off to one side, the belt can be tightened by loosening the stud-nut on the upper pulley and moving the pulley back. The assembler driving belt and the round belts which drive the keyboard rollers must be kept taut, though the pulleys on the latter are held by friction springs instead of being firmly fastened to the roller shafts, so it may be the pulleys are slipping though the belts are tight.

"Here's a little wrinkle I'll show you," continued the Machinist. "I've seen machinists and others digging out the bit of leather which remains in the coupling when one of these round belts break. Take hold

of the coupling with a pair of pliers, instead, and hold it in a flame a minute or so, and the leather will sizzle out as slick as can be."

## CHAPTER VIII.

### THE SPACEBAND BOX.

"I WISH you would explain this spaceband box mechanism," said the Operator, one day.

"All right," the Machinist replied; "take the box off and we'll take it apart. Shut off the machine and back her up until the second elevator starts down. Hold the spaceband shifter with one hand and with the other trip the latch in the first elevator cap (3, Fig. 27) and let the shifter go over easily. Remove the screw which holds the box (*A*, Fig. 15), and the screw in the electric-light bracket, and the whole apparatus will come off.

"Now remove those three screws (1, 1, 1,) in the spaceband chute, drive out the pin (*B*) in the pawl lever, and remove the two screws ($a^1$, $a^2$) in the side of the box, and that side can be taken off. You can now examine its internal arrangement.

"The spacebands slide down these inclined rails, supported by their ears, the first band resting against the hooks on the ends of the rails, the lower end of the spacebands being held by the pawl (*J*) in the bottom of the box. Their release is accomplished in this way: On each side of the box there is an upright pawl (*F*), held in place by the points of the screws (*C*) in the

lever (*K*), and drawn lightly backward by the springs (*D*), which fit into the slots in the lower end of the pawls. When the spaceband box is in position on the machine, the screw (*E*) rests on a lever which is connected with the keyboard in the same manner as the matrix keyrods are connected. This lever holds the pawl lever (*K*) in an elevated position, the points of the pawls (*F*) standing above the hooks on the inclined rails, and in front of the spaceband ears. When the space key is operated it first allows the pawl levers to drop, the points of the pawls being drawn backward by the springs (*D*) below the ears of the first spaceband, the return of the key lever causing the upward stroke of the pawls, which catch under the ears of the spaceband and raise it high enough to clear the hooks on the inclined rails, whence it drops down the assembler chute into the assembler."

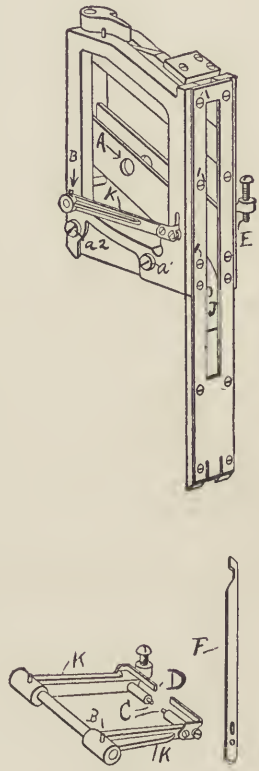



FIG. 15.

"That's very nice," remarked the Operator, "but sometimes the spacebands are not so accommodating; they don't always drop."

"Case of dirt, nine out of ten times," the Machinist responded. "The pawl levers (*K*) drop of their own weight and must be kept free. Of course, the parts wear. The pawls (*F*) should be removed and the points smoothed and squared on an oil stone. They should both be of exactly the same length so as to lift the spacebands evenly over the hooks. The hooks themselves wear and allow the spaces to slide too far forward in the box. Then the center bar must be adjusted, otherwise the pawls will lift two bands at a time."

"How is that adjustment made?" the Operator asked.

"See that plate on top of the spaceband box?" the Machinist replied. "The center bar held by the single screw is adjustable, and on its forward end are two pins which, when the bar is properly set, allow only one band to pass between them and the hooks on the rails."

"I suppose that screw (*E*) in the pawl lever is for the purpose of regulating the stroke of the pawls," ventured the Operator.

"Correct," replied the Machinist. "The screw should be set so that when the pawls are raised they stand about 1-16 of an inch above the hooks on the rails. It should be screwed down only far enough to do this. Now put the box together again, and when replacing it see that you get the key lever under the screw" (*E*).

## CHAPTER IX.

### THE LINE-DELIVERY CARRIAGE AND FIRST ELEVATOR.

"NOW that you have mastered the assembling devices," said the Machinist, "we'll take up the next step — the line-delivery carriage. The upright pin (1, Fig. 13) on the back rail of the assembling elevator, releases a catch or pawl, when the elevator is raised, which then allows the carriage, conveying the assembled line, to travel to the left. This pin (1) should lift the pawl 1-64 of an inch above the hook on the carriage, and is adjustable by means of a screw on which the pin sets, reached from beneath the assembler. As the line passes out of the assembler, the carriage trips the hook which held the assembler in an elevated position, allowing it to be lowered. I always hang a counterweight on the assembler lever so as to lighten the weight. As good a counterweight as any can be made by filling a quarter-pound tin can with molten metal and then inserting a nail, previously bent into an inverted U, into the metal just before it solidifies, thus making a loop by which it can be suspended from the lever by a strip of belt lacing.

"The line-delivery carriage, as I explained before, is drawn to the left by one of those heavy coil springs

in the hollow frame of the machine, but to prevent it going over with a slam, the carriage is connected to this air cylinder by a piston-rod, which allows the carriage to travel only so fast as the air can escape from the cylinder. Adjustable? Yes, by the valve in the outer end of the piston-rod. The felt packing around the piston wears out and can be renewed by taking out the screw by which the rod is connected to the carriage when the latter is sent over to the left into the first elevator. The link by which the carriage is fastened to the lever is also held by this screw, the knob on the other end of the link slipping under the latch on the lever, though on the old-style machines a flat spring was used instead of the latch. A few machines built recently were equipped with an adjustable piston-head so that when the packing became worn the head could be enlarged by spreading. The latest improvement in this air cylinder places the cylinder behind the keyboard in an upright position and attaches the carriage to it by means of a bell-crank lever.

"There are only two adjustments to this line-delivery carriage," the Machinist continued, "outside of the air-vent valve. One is the distance to which the line is carried to the left inside of the pawls of the first elevator — regulated by the thickness of the leather washer on the piston-rod in the air cylinder; the last matrix in the line should clear the pawls 1-32 of an inch. If the fingers of the line-delivery carriage are bent, the last matrix is liable to fail to get inside the elevator pawls and either fall off or get jammed in the vise when the elevator descends. The flat-spring pawls on these elevator jaws are a vast improvement over the

old lift-pawls, and these give much less trouble. The other adjustment of the carriage regulates the distance it can return to the right — adjusted by means of the eccentric pin in the roller which rests on the last cam (No. 10). It should be set so as to return the carriage far enough to allow the last notch on the latch to catch and hold it safely.

"Well, then, if you have grasped this idea," said the Machinist, "we will return to the first elevator, which has received the line of matrices. If the barrel of the connecting link on the bottom of the elevator is set right, the grooves in the elevator will be a trifle lower than the grooves in the intermediate channel, and the matrix line will enter the first elevator easily. The gibs on the elevator slide should hold the elevator snugly and not permit too much play. When the elevator descends, and the mold comes forward the first time, the lower ears of the matrices which fit into the aligning groove in the mold should have a play of 1-32 of an inch. If the elevator does not descend far enough to allow this play, the advancing mold will shear the top of the lower ears, and alignment will be an impossibility with such matrices. This adjustment is made by means of the screw in the elevator head which strikes on the vise cap. The other screw in the elevator head strikes on top of the vise automatic stop-rod (*K*, Fig. 18) and causes the machine to stop if the elevator from any cause (such as a tight line) is prevented from descending to its full depth.

"Another adjustment of the first elevator regulates the height to which the first elevator can rise when conveying the matrix line to point of transferrence to

the second elevator. The screw in the bottom of the elevator slide should be set so that the matrix line while shifting on to second elevator will rise a trifle and transfer easily."

## CHAPTER X.

### THE FRICTION CLUTCH.

"THAT'S what I've been trying to get through my noddle for a long time," said the Operator. "I haven't figured it out as yet, so I'll be glad to have you tell me how it works."

"All right," replied the Machinist; "there are a good many others in your same fix. I have an excel-

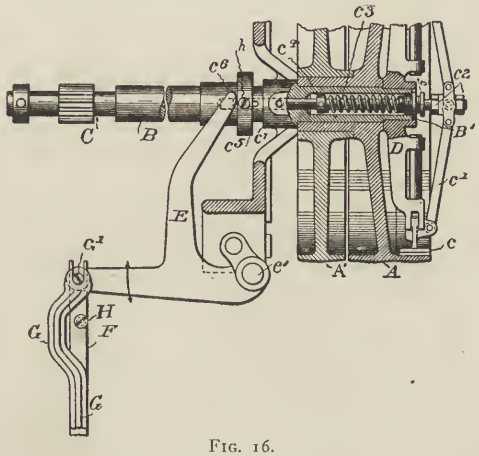



FIG. 16.

lent drawing of the clutch here (Fig. 16). *B* is the driving shaft of the machine, which is in two sections,

a taper pin holding the short piece, which carries the pinion *C* that meshes with the gear wheel of the main cams. The outer end of this shaft is hollow, a rod $c^4$ inside of it carrying a spring $c^3$, which tends to draw the rod inward. The inner end of the rod is fastened by means of the long screw-pin *h* to the collar $c^5$ which encircles the shaft, the hole in the shaft being slotted, so that when the collar is moved the rod $c^4$ is likewise moved. On the outward end of the shaft the friction clutch *D* is mounted, the levers $c^1$ being fastened to the end of the rod $c^4$. When the clutch is thrown into action, the collar *h* is released and the rod $c^4$ is forced inward by the spring $c^3$, thus drawing the levers $c^1$ inward and pressing the clutch leathers *c* against the inner side of the revolving pulley *A*, causing the shaft *B* to revolve and the cams to rotate. This is the position shown in the drawing. This position of the clutch is maintained until the stopping pawl on cam 10 comes in contact with the throw-off lever" (*a*, Fig. 17).

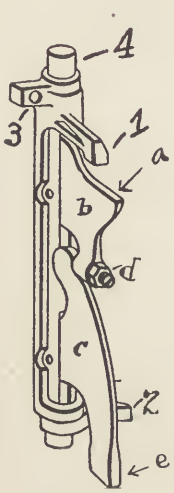


Fig. 17.

"How does that affect the clutch?" the Operator asked.

"The stopping pawl strikes on top of the lever (*b*), forcing it downward, the adjusting screw (*d*) pressing the lower end of the lever (*c*) outward, and as its point (*e*) presses against the forked lever *E* (Fig. 16), which is pivoted on the machine frame at $e^1$, you can

see how it causes the fork $c^6$ *to* push the collar $c^5$ outward and thus release the clutch leathers *c*.

"The last time the inspector was around here," said the Machinist, "he put a new connecting rod (*G*, Fig. 16) on all these machines, so that now the readjustment of the clutch does not affect the automatic devices in the vise. The clutch adjustment consists in allowing a space of 15-32 of an inch between the collar $c^5$ and the bearing $c^7$ when the clutch is in action, as in the drawing, this being regulated by the nuts $c^2$ on the end of the rod, and having 1-32 of an inch space between the end of the forked lever $c^6$ and the collar $c^5$, the screw in the stop lever (*d*, Fig. 17) being the means of making this latter adjustment. I have a piece of steel 15-32 of an inch wide and 1-32 of an inch in thickness which I use when setting the clutch, so measurements don't bother me. Now, however, the company makes the position of the clutch fixed by doing away with the nuts on the end of the rod and putting a screw through the levers."

"I saw you take off the clutch one day," remarked the Operator. "What was that for?"

"Because the clutch was slipping and wouldn't pull the machine around. The leathers were not oily but I found that the spring $c^3$ was weak. This spring should exert a pull of sixteen pounds. A spring scale showed it wasn't doing this, so I took it out and stretched it. The bushing *f* is for the purpose of making the spring stiffer, but in this case it wasn't enough. To take out the spring, the outer nut $c^2$ must be removed, the screw in the clutch frame loosened, and the clutch removed. Now the plate $B'$ can be unscrewed and the screw *h* in

the collar taken out, which releases the rod $c^4$ and the spring. Of course, the clutch leathers wear and they must be renewed and at all times kept free from oil."

"How does pulling out the controlling lever in front of the machine throw the clutch into action?" inquired the Operator.

"That screw *H* on the starting and stopping rod *F*" (Fig. 16), said the Machinist, "stands just behind the lug on the vertical lever (2, Fig. 17), and when the lever is pulled out the screw engages the lower lug and causes the upper lug (1) to push the stopping pawl off the stop lever (*b*), producing the same effect as if the line-delivery carriage were sent over. A spring pressing on the projection (3) retracts the vertical lever. These are the adjustments which should be maintained: Set the automatic stopping and safety pawls so that the distance from right edge of cam 10 to right side of pawls is 15-16 of an inch; then set the stop-lever rod (4), held by the small square-head screw in top bearing so that the pawls will rest on the stop lever (*b*) ¼ of an inch. By means of the plates carried by the pawls, set them so that the rollers will push them far enough to the right to clear the stop lever 1-16 of an inch. Adjust the vertical lever by means of the screw in the machine frame so that the lug (1) will clear the pawls as they pass 1-64 of an inch, and push them far enough to the right, when operated by the starting lever, to give a clearance of 1-16 of an inch between them and the stop lever."

## CHAPTER XI.

### THE VISE AUTOMATIC.

"THIS adjustment of the vise automatic is of the greatest importance," said the Machinist to the Operator, "for unless it is set just right the machine will chew up matrices as fast as they can be bought. When the matrix line is brought into casting position by the descent of the first elevator, the end of the adjusting screw in the elevator head strikes on the top (*K*, Fig. 18) of the stop rod (*E*), depressing it against the stress of the spring attached to the hook (*J*). The mold now advances, causing the sliding pin (*C*) in the vise frame to be pushed forward. If the elevator contains too many matrices, or for any other reason fails to settle down to its proper position, and the stop rod (*E*) is therefore not sufficiently depressed, this automatic dog (*C*) strikes against the pawl (*D*), causing the lower end (*B*) of the stop rod to strike against the stop lever, which in turn presses the connecting rod backward, and by so doing throws off the friction clutch, and the machine stops. You can see if it were not for this little device, serious mishaps would occur. When the set-screw in the elevator head is properly adjusted, the sliding pin or dog (*C*) will just clear and pass over the pawl (*D*) when the first elevator rests on the vise cap."

"Some time ago," said the Operator, "I found one of those automatic dogs (*C*) wedged tightly in its socket so it couldn't move. I didn't see then how you fixed it."

"Well, I'll explain that now," said the Machinist. "There had been a 'squirt' on that machine, and the

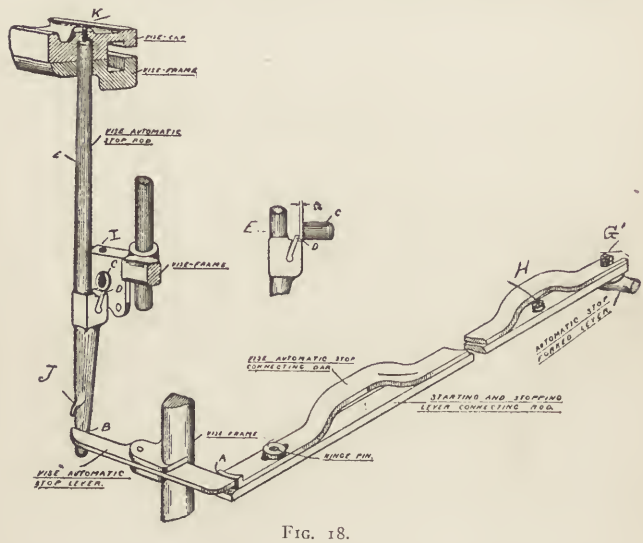



FIG. 18.

metal had run inside the hollow pin and filled up the spring inside of it so it couldn't retract the pin when the mold retreated. I merely removed the dog by taking out this screw (*I*), and after driving out the small pin which confines the spring, removed the metal. In replacing the dog you must be sure the screw (*I*) goes down between the spring and the small pin and leaves the dog to slide freely. An improvement is made

in the late machines in putting a screw cap in the back end of the automatic dog, so it can be removed and the spring taken out that way.

"You will notice," continued the Machinist, "that the controlling lever acts on the lower connecting rod, while the vise automatic acts on the upper connecting rod, making the clutch entirely independent of the adjustment of the automatic devices. The only adjustment of the under rod is the pin (*H*), which is an eccentric and should be set so it rests lightly against the vertical starting lever when the machine is at rest. Pushing the controlling lever backward throws the clutch out of action by the screw (*G'*) acting on the forked lever.

Fig. 19.

"There is another device which has an important relation to the first elevator, though its adjustment thereto is often disregarded, with the usual dismal results. I refer to the knife wiper (Fig. 19). Unless it is free to move up and down, the descent of the first elevator may be interfered with and will leave the impression that the automatic stop screw is not set low enough. The wiper should descend of itself and not be drawn downward by the latch stud in the first elevator lever. The principle is this: After a slug has been cast, the first elevator rises, the latch stud on the lever coming in contact with the bottom of the wiper bar (1, Fig. 19), pushing it upward until the notch (*a*) slips over the stop rod in the bar

guide, the end of the latch rod (2) coming in contact with the vise frame and causing this piece to be pushed downward against the stress of the spring (3). When the first elevator descends to normal position, the wiper bar remains elevated, the stop rod holding it at the notch (*a*) until the retreat of the mold after ejectment of the slug allows it to slip out, and the buffer spring (3) then retracting, causes the wiper bar to drop and the wiper (4) to be drawn the entire distance of the knife edges to remove the shavings of metal. The wiper bar will drop freely if the flat bar spring is not binding it too tightly or shavings of metal are not clogging it. The latch (*b*) is merely a safety arrangement to compel descent of the wiper bar should it fail to act properly.

"Of course," continued the Machinist, "the wiper (4) will be cut through after a time and break off, but it's only a few minutes' work to remove the wiper bar and rivet or solder on another piece. Open the vise, loosen the flat bar spring which confines the rod and slip it to one side, and with the pliers pull out the taper pin in the vise frame directly underneath this spring. This allows the wiper bar to be slipped down and out.

"Never attempt to lower the vise," cautioned the Machinist, "when the mold is forward on the locking pins. To lower the vise to its second position, slip back the spring stud on which the vise frame rests when the vise is open, and when lowering the vise pull upward on the elevator to avoid breaking the connecting link.

"In closing up the vise it is not necessary to throw all your weight on the locking screws, as I've seen some people do — merely bring them to a bearing."

## CHAPTER XII.

### THE MOLD DISK.

ONE day, after changing the machine from a narrow measure to a 30-em line, the Operator reported that the lines were not justifying, and that a "squirt" of metal would occasionally occur on the end of the line. He appealed to the Machinist for a remedy.

"It may be because the justification springs are not strong enough to push the large number of spacebands through the 30-em matrix line," said the Machinist. "Get a small round rod and slip it through the hole in the bottom of the justification-spring rod, so the rod can not turn, and then, with a wrench, screw down the nut on the top of the spring to make the tension greater. Do this with both springs. If the spaces still come up with difficulty, it will be necessary to change the adjustment of the eccentric, which is probably causing the mold to lock up so tightly against the matrix line as to interfere with its sidewise movement during justification.

"You'll have to show me that," replied the Operator. "You know where I'm from."

"All right," replied the Machinist. "Come around to the back of the machine and I'll explain. This lever (*A*, Fig. 20) carries two rollers (1, 2), the front one

fitting in the depression (*B*, Fig. 21) of the mold slide (*C*), while the back roller (1) works in the groove of the gear cam. This connects the mold slide to the cam and causes the former to advance and retreat as demanded. The adjustment I speak of is in the back roller, the pin of which (*D*, Fig. 20) is an eccentric. By loosening the set-screw (3), the handle (4) can be raised or lowered, causing the mold to lock more or less tightly against the matrices before the cast occurs. To slacken the pressure, raise the lever a trifle and make the set-screw fast again."

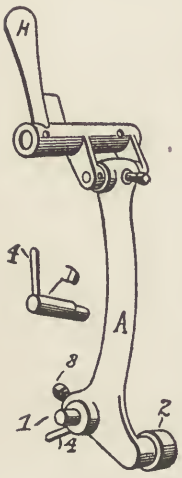


FIG. 20.

"What is the purpose of the lever which is connected to the upper portion of this apparatus?" asked the Operator.

"This is an arrangement for disconnecting the mold slide so it can be drawn forward. When the handle (*H*) is depressed the lever (*A*) is raised and the mold slide freed. With the vise lowered to the second position and the jaw guard on the mold disk shield removed, the mold disk can be drawn forward to get at the pot mouth or set a back knife."

"How do you do that?" asked the Operator.

"Setting a back knife requires patience and practice," replied the Machinist, "but I'll tell you how I do it. First I see to it that the disk is running true. If it is not, I adjust it by the screws (7, 8) in the boxing until it spins around without a wobble. Then I loosen

the screws which hold the knife and screw up on the adjusting screws (5, 6) until the knife edge just touches the back of the mold, when I slightly tighten the screws which hold the knife. After spreading red lead or prussian blue on the back of the mold, I turn

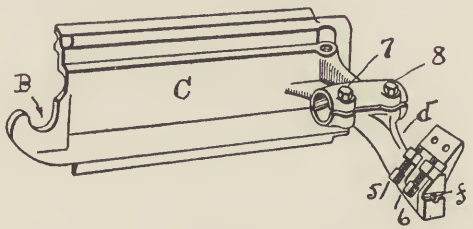



FIG. 21.

the disk around and adjust the screws (5, 6) until the knife rubs equally over the back of the mold without binding tightly, and then I tighten the knife screws. Then the guide block is adjusted to set snugly by means of the tap screw (*f*). When the back knife is properly set its edge will bear evenly on the back of the mold, and it will then run a long time without needing regrinding."

"I suppose an improperly set back knife will cause 'high lines' to be produced," remarked the Operator.

"Yes, that is the popular impression," responded the Machinist, "but nine out of ten times the cause of 'high lines' is an accumulation of metal on the face or back of the mold. If a little oil is mixed with graphite and rubbed into felt mold wiper, metal will not gather on the mold face, while the back of the mold should be examined frequently, cleaned and polished. Never

touch the back of the mold with anything harder than brass. You are liable to round off the edges of the mold cell, as I have known some to do with emery cloth, and ruin it. The best scheme is to attach a wiper similar to the front mold wiper so that it keeps the back of the mold clean. A mixture of oil and graphite should be rubbed into the felt of the wipers, and then metal can not accumulate on the mold and 'high lines' will be unknown."

"That jaw guard you spoke of," said the Operator; "what is that for?"

"That is to prevent the back jaw of the first elevator being sprung by the withdrawal of the slug from the matrix seat after casting," said the Machinist. "Keep it on always while the machine is running."

"I suppose the vise jaws are adjustable, are they not?" questioned the Operator.

"Oh, yes," relied the Machinist. "The right-hand jaw has a set-screw behind it, while the other jaw is adjustable by means of the screw in the bracket in the left-hand end of the vise frame. If the face of the type overhangs the body of the slug or if the face does not fully cover the slug, it is remedied by these vise-jaw adjustments."

"When the mold disk comes forward it slides up on those locking pins in the vise frame; do those pins need resetting?" the Operator asked.

"Hold on there," gasped the Machinist. "You're going too fast. You'll want to be changing every movable part on the machine first thing I know. But keep away from the locking pins — they are set by jigs in the factory and should never be changed. As a

matter of fact, the less you use the screw-driver and wrench the less you'll need to. Paste that in your hat."

"Does that caution also apply to the mold disk," asked the Operator. "Doesn't it ever have to be removed?"

"Well," the Machinist replied, "as a rule it is not necessary to do so, but if the mold-disk stud is not properly oiled and runs dry the stud will become galled and bind so that the disk can not turn. There is a good deal of heat near this bearing, so it will get dry if not watched. The mold wheel or disk can be removed by taking off the mold-disk guide (*f*, Fig. 21) when the mold slide is pulled forward, and with a piece of brass driving the mold stud-nut (*g*, Fig. 22), to the left to loosen and remove it, when the mold wheel will come off easily enough. If the mold stud has been galled it must be removed and smoothed with emery cloth; then cleaned and oiled and replaced. Tighten up the back screw (*7*, Fig. 21) so the stud can not slip when you put the disk back on the stud, and after putting the stud-nut on again you can loosen the back screw until the disk spins freely and truly; replace the disk guide, and there you are. Now, don't take off the mold wheel every time it appears to be binding. Find out first if it is the disk that is stuck. If it can not be turned by hand when the mold-turning pinion (*H*) is drawn out of mesh, that will locate the trouble in the mold wheel, but it may be that metal has run in between the flange on the disk (*e*, Fig. 22) and the arm (*d*, Fig. 21), or between the disk and the ejector guide, and is thus preventing the mold disk from revolving. If it is the latter condition which is causing the trouble, it may be

necessary to remove the ejector guide to dislodge the metal."

"Oh, yes," interposed the Operator; "I've seen you do that. You pull the disk forward and take out the two screws which hold the guide in place."

"That's right," responded the Machinist. "Keep your eyes open and you'll learn more than I can tell you. Whenever you remove the guide, notice if the spring plate in the guide itself is free to move. Sometimes metal runs behind the movable plate and holds it so rigidly that the ejector blade can not be advanced through the guide to eject the slug."

"Tell me how you adjust the ejector so it will deliver the lines into the pan properly," said the Operator.

"That is accomplished by raising or lowering the pawl on the ejector lever which stands above the cams in the rear of the machine. This pawl is caught by the lug on the gear cam when the machine revolves. If the pawl is set lower it causes the ejector to be advanced farther through the mold; if raised, the line is not ejected so far into the pan. Sometimes, when using a 'wrong font' or a short ejector blade it is necessary to put a plug of wood or paper to hold the spring plate in the knife block open so the slug will eject without tipping over.

"While I'm at it," continued the Machinist, "I'll show you how the mold disk is revolved by the mold-turning cam (No. 2). Take off the guard which covers the gearing and you can see the whole works. This square block (*F*, Fig. 22) lays against the inside surface of the cam. When the cams revolve, the toothed seg-

ments (*A, B,* Fig. 1) come into mesh with the beveled gear (*C*), imparting rotation to the short shaft (*S*), which, being geared to the mold-turning shaft (*O*), causes the mold disk to be revolved."

"What is this other arrangement (*B,* Fig. 22) for?" asked the Operator.

"That is a brake," answered the Machinist; "it's purpose is to relieve the strain on the square block (*F*) when it is stopped in its revolution by coming in contact

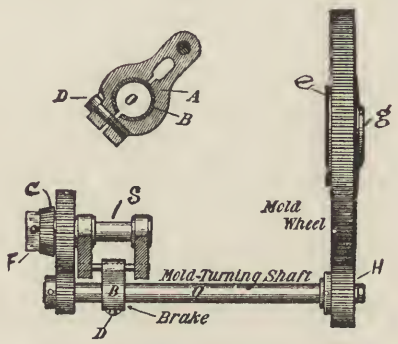



FIG. 22.

with the cam surface. The brake consists of a leather lining (*B*) inside of the brake (*A*) which encircles the mold-turning shaft (*O*). This brake can be adjusted by means of the screw (D) so that the disk will stop quietly and smoothly without a jar.

"When the block (*F*) wears so that it no longer fits snugly against the cam, the cam shoes against which the block strikes when stopping can be set closer to the block by loosening the screws and underlaying the shoes. A screw in the square block, the head of which

shows uppermost when the parts are in their normal position, can be removed, and this allows this part to be taken off if necessary to patch a worn block.

"The rollers on the various levers also should be watched," continued the Machinist, "and if any of them fail to revolve freely they should be promptly removed and cleaned, or they will wear a flat side and affect the adjustments."

"I notice," said the Operator, "that slugs are not continually sticking in the mold. I have worked in offices where this was an hourly occurrence. How do you prevent it?"

"Well, I'll tell you," replied the Machinist. "If your casting apparatus is all right you'll get a good, solid slug each time, into which the ejector blade can not sink when ejecting. Then the mold liners must be perfectly smooth and true — not sprung or battered by hammering out slugs with a piece of hard metal and a hammer. The mold should be taken apart occasionally and the mold cell cleaned and polished, and the trimming knives kept sharp and set properly, and then if the metal is not allowed to get hot or the pot empty, slugs will rarely fail to eject. But should a slug stick in the mold, don't hammer it out. I've got a plan worth two of that. When she sticks, back up the machine a trifle and retract the ejector blade by pulling back on the ejector-lever handle, and then raise the ejector pawl and turn the machine forward so that the lug passes under the pawl, allowing the machine to come into position with the stuck slug still in the mold. Now pull out the starting lever and let the machine roll around, and by holding down the second-justification

lever throw the pump stop out and allow another cast to be made into the bottom of the old slug, which will almost always then eject easily. With the new universal mold you can loosen the mold-cap screws and release a stuck slug that way. But if hammering is necessary, do not use anything harder than brass either for an ejector or to pound with. A squirt of oil on the foot of the slug will make it drive out easier. For my part, I prefer a preventive. It's easier on the machine and your knuckles."

## CHAPTER XIII.

### THE METAL POT.

THE Operator was just beginning to think he knew all there was to learn about the machine, when he ran against a snag. "What is the matter with the metal on this machine?" he asked the Machinist. "It keeps squirting behind the mold disk. It don't appear to be too hot, as the metal gets cold if the heat is reduced. This is a new one on me, so I'll have to ask you to help me out."

"Let's see," said the Machinist. "Perhaps metal has gathered on the pot mouthpiece or behind the disk and is preventing the pot from locking up tightly against the mold."

He lowered the vise, removed the jaw guard on the mold shield, disconnected the mold slide, drew the disk forward and examined the mouthpiece and the back of the mold.

"It doesn't seem to be that this time," remarked the Machinist. "The mouthpiece is most likely warped by the constant heat and needs 'facing up.' There are several ways of doing this, but I'll show you my way, and I have always found it effective. It is this: Spread prussian blue over the back of the disk at a point between the molds — not on the mold itself. There is a

perfect surface there and it's just as true as the mold itself. Then connect up the disk in such a position that when the machine is started by pulling out the controlling lever, that portion of the disk covered with prussian blue, instead of the mold, is presented to the pot mouth. The pump-stop prevents a line being cast, but the pot mouth, coming in contact with the prussian blue, leaves its impression therein and itself receives a transfer on its face, thus showing, when the disk is drawn forward again, just what spots are highest on the mouthpiece. These spots must be smoothed with a file and the test again applied, repeating the process until the impression shows an equal pressure the whole length of the mouthpiece.

"Of course, if you allow the disk to revolve after making the impression, the back knife will scrape the prussian blue from the back of the mold disk, but if you remove the ejector blade and the mold-turning pinion, and hold the disk in position with your hand, it can be kept stationary while the machine completes its revolution.

"The cross vents must be put in again after filing the mouthpiece," continued the Machinist. "A small cold-chisel is best, but the file should be rubbed over the mouthpiece afterward to dress down the roughness caused by the chisel. Care must be taken to not extend the vents above the top of the holes in the mouthpiece. These vents are for the purpose of allowing the air to escape from the mold cell when the slug is being cast. When the mouthpiece is properly faced up, only the cross vents and the jets are trimmed by the back knife. A smooth-bottomed slug indicates an imperfect lock-up.

"You must be wary, however, of filing the mouthpiece too freely," cautioned the Machinist. "Take off but little at a time, and hold the file squarely with the face of the mouthpiece. If the impression taken shows that the pot is locking very tightly on one end and not on the other, it is sometimes better to swing the pot around by means of the adjusting screws in the bottom of the pot legs. For instance, if the impression indicates that the left-hand end of the mouthpiece (*X*, Fig. 23) is being pressed too tightly against the mold, loosen the front screw (1) and screw in on the back screw (2) on the left pot leg (3). This will throw this end of the pot mouthpiece further back, and, if done carefully, will result in a square lock-up. The screws must be tightened and the jam-nuts also, or the pot will work loose and give trouble."

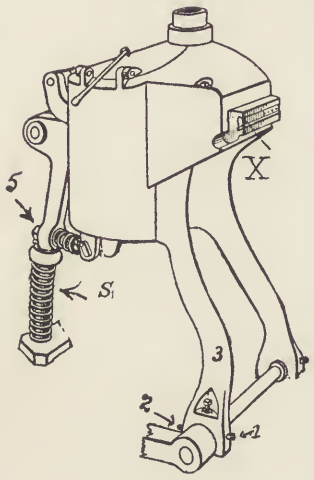


FIG. 23.

"What are those other screws in the pot legs for?" asked the Operator.

"They are for the purpose of adjusting the height of the pot to cause the mouthpiece holes to align with the mold cell," the Machinist replied. "When they are set right, the jets will show round and full on the bottom of the slug, and will always be in line with the

smooth edge of all sizes of slugs. On the new machines there is a cross-piece on the bottom of the pot legs with an adjustment in it also to prevent the pot being lifted."

"Does the lever back of the metal-pot need adjusting?" was the Operator's next question.

"No," responded the Machinist; "when it is once set right it will be all right if left alone. That is a spring action to lock the pot against the mold with spring pressure. If the lever is set so as to allow the spring to act, that is all that is necessary. When the pot is forward there should be a space of 1-16 of an inch between the lever and the outer nut (5) on the eyebolt. The roller in the pot lever has anti-friction roller bearings, similar to ball bearings, and for the purpose of relieving the roller from the weight of the pot, a balancing spring (*S*) is seated beneath the pot lever to help support the pot."

"Why do you have some of the burners under the pot turned partly off?" asked the Operator.

"So as to get the best possible blue blaze from each. Some will burn better when turned partly off. There has been considerable change in the burners lately put on machines. The newest one has one ring burner under the pot and four tubes under the throat and mouthpiece."

"I notice," said the Operator, "that when a machine has been running on short measure for some time, that the unused mouthpiece holes get plugged up, and I always have to run a steel wire through them to open them up again. I have even seen people drill them out, they were plugged up so tightly. Does poor metal cause this?"

"Not always," the Machinist replied, "though that will make it worse. If heat is applied to the mouthpiece when the wire is pushed through the holes they will generally open up readily. It is sometimes necessary, though, to take out the mouthpiece to clear out the dross behind it. This is done by driving the mouthpiece toward the keyboard to loosen the wedge-shaped key which holds it in place. It can then be removed and the dross and litharge cleared out. See that the throat is open all the way and that the hole near the bottom of the plunger well is open. If necessary, dip all the metal out of the pot and examine it. The utmost care must be taken when driving out the mouthpiece to avoid battering the end, as this battered end will break the mouth of the crucible while you are driving, and cause leaks when replaced. When replacing the mouthpiece, if a mixture of oil and graphite is spread on the beveled edges it will help to prevent leaks. There are pot-mouth extractors sent with machines nowadays with which the mouthpiece can be drawn out without driving."

"Does the tension of the pump-spring need to be changed at times?" the Operator asked.

"Not necessarily," said the Machinist. "If the plunger makes the full stroke that is all that is needed. The pump spring on the new machine works in the hollow frame of the machine and is a light affair, and this massive pump spring and bracket is done away with.

"Here's a job for you, by the way," continued the Machinist. "Take out the pump plungers and brush the dirt and oxide from them. Scrape the inner side of

the well to remove the scale, which if left will prevent the free action of the plunger. The rings on the plungers after a time become worn and allow metal to escape around them when the pump descends to make a cast, and a porous slug and sunken letters in it is the result. The rings can be removed and new ones applied by removing the nut on the bottom of the plunger. The latest plunger is a solid piece, this also being the earlier form."

"Does the pot ever have to be taken out of the machine?" questioned the Operator.

"Only in case of accident to the crucible," replied the Machinist. "You see the pot consists of two parts, the crucible and the jacket. Magnesia plastic is packed between the two, as this is a splendid non-conductor of heat. The cap of the pot is then bolted on. I have known the crucible to crack from expansion or contraction due to sudden changes in temperature. Every time a mouthpiece is removed there is danger of chipping the crucible, and for that reason I don't believe in taking one out unless every other means fails. The latest thing in mouthpieces, however, overcomes this danger, as the mouthpiece is clamped in place by a removable section, and it can be taken out and replaced with impunity."

## CHAPTER XIV.

### THE METAL AND TRIMMING KNIVES.

THE Operator had heard considerable talk about good and poor Linotype metal, so one day he asked the Machinist what made the difference between them.

"Poor Linotype metal," replied the Machinist, "contains very little tin and antimony, and is consequently soft and spongy. On account of the comparatively high cost of these ingredients, Linotype metal containing the proper percentages of them is expensive. Just what these proportions are the makers refuse to divulge. Lead, however, is the base, and comprises probably seventy-five per cent of the whole mass. Antimony is added to impart hardness. Lead and antimony, however, are not homogeneous and the addition of tin is necessary as a flux."

"But the metal deteriorates, doesn't it?" queried the Operator.

"Yes," responded the Machinist. "Constant remelting and high temperatures eventually release the tin and antimony, and these being skimmed from the surface of the metal with the oxide as dross, the metal remaining is too soft for Linotype uses. Metal deteriorates much faster if allowed to get too hot — above

550 degrees. As tin has a much lower melting point than lead, it is gradually burned out, and the slugs then are porous and break easily. With the loss of the tin, the two remaining metals will not amalgamate, the antimony rises to the surface on account of its less specific gravity, and is skimmed off as dross. If the heat is allowed to become excessive, the antimony rises to the surface as a black powder, but as this will not occur unless the heat is about 800 degrees, there is no occasion for permitting it."

"Do you ever retemper the metal when remelting it?" the Operator next asked.

"Not ordinarily," replied the Machinist. "I occasionally plunge a stick of green wood into the smelting furnace and let it boil about twenty minutes. That will liberate the oxides and purify the metal, while a small lump of rosin added to the mass when the skimmings are remelted will reduce the dross. Too much rosin in the metal, though, will make trouble in the machine metal-pot by clogging the mouthpiece and the plunger. It must be used very sparingly. When the metal needs retempering I box it up and ship it back to the refiners from whom it was bought. As they know exactly what the proportions are, they are better able to add the necessary ingredients to bring it up to standard. If you want to get the best results, this should be done every three months.

"We will have a chance to-day to sharpen the trimming knives on a few of these machines," continued the Machinist. "It is some months since they were attended to and they need it. You can remove the whole knife-block and right-hand trimming knife by taking out the

two large tap-screws in the block, the upper one of which holds the mold wiper in place. The two screws which pass through the knives from the front of the block (1, 2, Fig. 10) must then be removed, and the knife is free. While you have the block apart you can see how the lowering of the wedge adjustment moves the knife closer to the stationary or left-hand knife to trim a thin slug, and how the flat spring within the block retracts the knife when the wedge is raised to trim a thicker slug. The latest improvement in this is the placing of two heavy springs to retract the knife instead of the one flat one in these blocks. A further improvement is in holding the knife by means of friction spring plates instead of the bolts (1, 2), which in these blocks must be loosened before moving the wedge. With the new block it is only necessary to raise or lower the lever to change the position of the knives.

" The left-hand knife can be taken off by removing the two bolts reached from the front of the machine when the slug-receiver, or pan, is removed.

" Now get the lapping block and sprinkle the surface of it with fine emery powder and moisten it with benzine. Then place the knife first with its entire surface resting on the block and rub it back and forth to sharpen the edge and remove any nicks. Next turn the knife over and give the beveled edge of it a few rubs. Finally, hold the knife against a supporting block, and

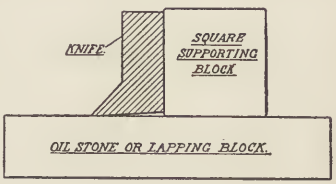



FIG. 24.

in such a way that the flat under-surface of the knife lies close against the support and the cutting edge of the knife only rests on the lapping block (Fig. 24). Holding the knife in this position, slide both back and forth to make a parallel surface on the cutting lip of the knife, but do not extend it further back from the edge than 3-32 of an inch. This is done to prevent the knives gouging into the slugs when trimming. The knives should be sharp, but not have a razor edge.

You will notice," the Machinist continued, " that the surface of the knives taper backward to the base, and also outward from top to bottom (See Fig. 25).

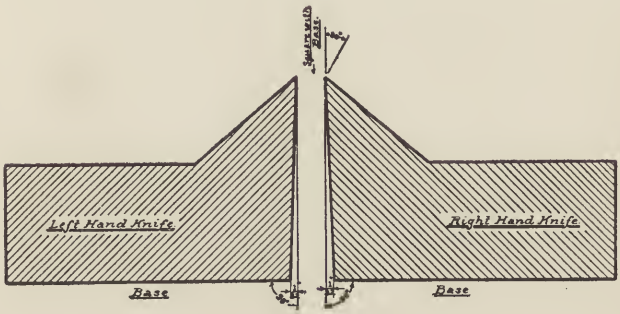



FIG. 25.

This allows the slug to be ejected with the least possible resistance. The knife for trimming the base of the slug is also sharpened in the same way. The original angles must always be preserved when sharpening. When replacing the knives, do not tilt them by underlays of paper or other means, so as to put the cutting edges at a different angle from that originally intended, as I have known some smart machinists to do. Fasten

them down the way they were made to fasten and you will have no trouble. The worst difficulties Linotype inspectors encounter is caused by that class of machinists who think they know more about the machines than the man who built them, and then proceed to alter the parts."

## CHAPTER XV.

### MATRIX AND SPACEBAND TRANSFER.

WHILE talking with the Operator one day, the Machinist said: "Do you remember how, every once in a while, a line of matrices would be dumped into the thin-space receptacle when the line was being transferred from the first elevator?"

"Indeed I do," replied the Operator. "That was one of the first things you fixed when you took charge here. Perhaps I might understand it now if you would explain it."

"All right," replied the Machinist; "I'll try. You see this screw in the bottom of the first elevator slide? That is an adjustment for regulating the height to which the elevator can rise when carrying a line of matrices to the second elevator. The screw must be set so that the guide-block on the elevator jaw will come in line with the groove in the guide-block on the end of the transfer carriage (*A*, Fig. 26). The transfer carriage is drawn to the right by the coil spring in the hollow frame of the machine, back of the assembler. The lever which operates the carriage has a roller which follows the surface of cam No. 10. This roller has an eccentric pin, the same as the line-delivery carriage roller has, and when this eccentric is properly set it

will cause the shifter finger (*B*, Fig. 26) to retreat far enough, after transferring a line of matrices, to allow the trip lever (1) in the elevator guide (Fig. 27) to drop in front of the projection (2) on the transfer carriage (Fig. 26), so as to lock it in that position. Now the transfer carriage can only be released by the latch being lifted, which the second elevator does when it comes down. This is accomplished by the adjusting screw on the arm striking on top of the trip lever (3,

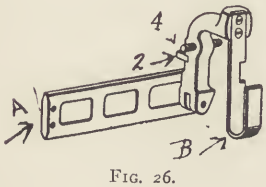



Fig. 26.

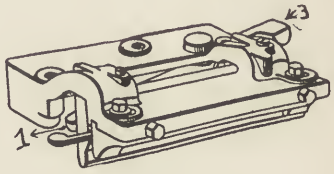



Fig. 27.

Fig. 27). This lifts the other end (1) of the trip lever, which normally lies in the path of the projection (2) on the transfer carriage, and permits the transfer to be made.

"The lever which moves the transfer carriage is connected to the lever which operates the spaceband shifter pawl by a link and turnbuckle, which you can see right behind the keyboard cams. When the transfer carriage moves, the spaceband shifter moves also. If the shifter pawl is locked by the operator — as is done when recasting lines — this, of course, prevents the movement of the transfer carriage.

"This transferring device, you see," continued the Machinist, "is safeguarded in three ways. First, if the first elevator does not rise high enough to allow the

guide-blocks to meet; second, if the second elevator fails to descend, which will occur if the distributor stops and matrices partly on the bar and partly in the distributor box hold the arm in its upward position; third, if the spaceband shifter pawl is locked back by the operator.

"Now as to the cause of the matrices dumping into the thin-space box: In the first place, the cam roller was not set so as to return the transfer carriage far enough to allow the trip lever to lock it, so if the second elevator did not descend, there was nothing to prevent the action of the transfer, which proceeded to shift the matrices into the intermediate spaceband channel, from whence they would fall into the thin-space box. There is a punch-mark on the sprocket-shaped head of the eccentric pin which indicates where to place the screw which holds it when the parts are not worn. I reset the roller and then adjusted the turnbuckle so that the spacebands were swept fairly back into the spaceband box each time, and then, with the second elevator down in its lowest position, I set the screw on the arm which unlocks the trip lever so that the end (1) would clear the projection (2) about 1-32 of an inch. That settled that trouble. There is a new arrangement on the latest machines for setting the transfer carriage, and it's much handier than to adjust the eccentric pin. The short lever or arm which carries the roller is fastened to the shaft by a split hub, with screws to clamp it tightly. To set the transfer you merely loosen the screws and move the whole arm in either direction necessary and tighten up the screws again."

"What causes the spacebands to get stuck in the intermediate channel and fail to be returned to the spaceband box by the shifter pawl?" the Operator queried.

"That is usually caused by the screw (4) in the shifter finger (*B*, Fig. 26) being turned in so far that it prevents the two shifters from coming close enough together to enable the pawl to drop over the ears of the spacebands. It may be, though, that one side of the intermediate spaceband channel is higher than the other and lets the bands swing around. If that is the case, the whole channel must be taken off, the dowel pins removed and the low side raised so a band when hanging from the rails is supported equally by both ears."

"I understand that now, I guess," said the Operator, "but I don't just see what stops the machine when the transfer carriage fails to act."

"Well, you'll have to go back to a former lesson if you don't grasp that proposition," replied the Machinist. "You remember that when I explained the action of the various cams I showed you the safety pawl on cam No. 10. That pawl lies in the path of the stop lever which throws the clutch out of action, and this pawl will come in contact with it unless the roller on the transfer lever pushes the pawl to the right and so allows it to pass by the stop lever. If the roller is prevented from following the cam surface, as it would be by the transfer carriage being caught or the spaceband pawl being locked, this safety pawl would stop the machine. In this event, a pull on the controlling lever disengages the safety stopping pawl and the machine will finish its revolution."

## CHAPTER XVI.

### SECOND ELEVATOR AND DISTRIBUTOR BOX.

"HERE is something I want to show you," said the Machinist. "It isn't very often that the second elevator gets out of adjustment, but you had better know how to fix it when it does. Come around to the back of the machine and I'll show you how.

"You will notice," the Machinist continued, "that the second-elevator lever is in two parts, with a cushion spring between the two pieces, near the base. If you will back up the machine far enough to allow the second elevator to descend a little way and then loosen or tighten the nuts which affect this spring, you will see that it causes the lever to move a trifle. When properly adjusted, the lever will seat the second elevator firmly back against the guide-block when in its full upward position. As it descends by its own weight, it will then always seat itself properly in the intermediate space-band channel to receive the matrix line. A spring attached to the lever assists in starting the elevator downward, and also serves to steady it on its return, this spring passing beneath the machine frame between cams 1 and 2. If the spring is not stiff enough, or is broken, the elevator will occasionally trip up and fail to seat itself in line with the distributor box, and perhaps damage the grooved bar in the box. There is

a nut on the rod which can be tightened to give proper tension to the spring.

"On the opposite end of the second elevator, also beneath the shaft, there is a safety pawl, the object of which is to prevent the elevator from falling and getting damaged or broken should anything catch and hold it momentarily while the cams continue their revolution. The pawl engages with a hook on the machine frame and this hook has to be released before the elevator can be lowered by hand. In this case, the spaceband-transfer pawl must always be locked back and unlocked when the elevator has been lowered, meanwhile holding the shifter lever to prevent it transferring the line too swiftly."

"What is that little trigger arrangement on the end of the second-elevator bar?" asked the Operator.

"That is a pawl which prevents the matrices from sliding too far to the right when being transferred from the first elevator," replied the Machinist. "Without some arrangement of that sort the matrices might slide over so far as to strike against the distributor-box bar when the elevator rises, and damage it."

"I'd like to see the internal arrangement of the distributor box," ventured the Operator, "if you'll take it down some day."

"I'll do it now," said the Machinist; "we have a little time."

After backing the machine until the second elevator descended from its seat, he threw open the magazine entrance and pressed downward on the lever handle which kept the box in position, thus releasing the box, which he then drew downward and placed on the bench.

"First of all," he said, "you must understand how the matrices are lifted one by one to the combination bar for distribution. The matrices are shifted from the second-elevator bar to the distributor-box bar, and are pressed toward the distributor by the spring-actuated shifter. The distributor is equipped with three horizontal screws, between which the matrices are urged forward until they reach their proper channels. One of these distributor screws has a cam on its right-hand end which engages the matrix-lift lever (*L*, Fig. 28), causing the lift (*I*) to rise and fall. As the point of this lift lies just beneath the first matrix in the distributor box, it results in that matrix being lifted to a height which allows the distributor screws to engage the matrix ears, and as they revolve they push the matrix forward. The upper ears of the matrix now rest upon the inclined rails (1, 2), and as they move forward and upward the teeth on the matrices engage the combination distributor bar, from which they are thereafter suspended."

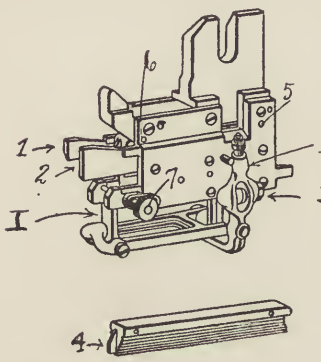


FIG. 28.

"Is the nut (3) an adjustment for the lift?" the Operator asked.

"Yes," answered the Machinist; "that regulates the stroke of the lift. It must be set so that the lift (*I*) will raise the ears of the matrices 1-32 of an inch higher

than the rails (1, 2). The cushion spring beneath the adjusting screw prevents breakage."

"What was that you replaced the other day when the lift kept picking up two matrices at a time and stopping the distributor?" the Operator next asked.

"That was caused by the bar pawl (4) being worn. You have noticed, I presume, that all matrices have a groove down the center on the left-hand side (see Fig. 32) deep in the thick matrices, shallow or not at all in thin ones. As a space wide enough for the thickest matrix to be lifted to the distributor bar might permit two thin ones sticking together to be raised at one stroke, all matrices are cut to a uniform thickness at this point, and a pawl (4) which stands in their path above the matrix lift (*I*) enters this groove and will allow only one to pass at a time. If the point of the pawl wears off or the upper or lower rails in the distributor box wear enough to allow two thin matrices to pass, these parts must be renewed. The point of the lift (*I*), although case-hardened steel, will also wear, and will then have a wide enough seat to pick up two thin matrices at a time. Of course, a new lift must then be put in."

"Is it much trouble to take the box apart?" questioned the Operator.

"No, it's done easily," replied the Machinist. "The grooved bar can be removed by merely pushing out the two pins (5, 6) which hold it. The front side of the box can be removed by taking out the three upper screws.

"While we have the box down you may see how you can, by turning the stud-nut (7) as far as it will go

to the right, throw the font distinguisher out of action so that it will not stop any wrong-font matrices which you might wish to run in without stopping their distribution. This is a new feature which is not to be found in earlier machines. The large groove in the bottom of the matrix is the font mark. The smaller marks distinguish the different faces from each other. Never attempt to turn the stud-nut (7) when there are matrices in the distributor box. You will be liable to break off the font-distinguishing lip if it catches on a matrix.

"Be careful," continued the Machinist, "in replacing the distributor box that you seat it as high as it will go and as far to the left as you can before turning the lever to the left, or upward, to fasten the box in place. On the new machines a couple of pins in the distributor-box casting prevent the box being placed in any other than the correct position."

## CHAPTER XVII.

### THE DISTRIBUTOR AND THE MAGAZINE.

"THERE isn't a great deal more that I can tell you about the Linotype," said the Machinist to the Operator, "as I have explained nearly every part of the machine except the distributor and the magazine. There is something to learn about these parts, however, so I'll tell you what I can about them.

"In the first place, don't get the idea that the distributor bar is at fault whenever the distributor gives trouble. The bar is made right and set right, so don't 'monkey' with it. If the matrices fall into the wrong channel or clog in the distributor entrance, it is usually because the magazine is not set right. The two adjusting screws (*A*, Fig. 29) on either side of the magazine are for the purpose of setting the magazine in proper relation to the distributor bar. Throw the distributor belt off and turn the distributor by hand and set the magazine so that when the matrices fall from the bar they will just clear the partitions or guides. When the distributor is running normally the momentum given the matrices will carry them to the center of the channels. The other adjusting screws (*B*) on the magazine must be set so as to leave a space of 1-16 of an inch between the bottom of matrices suspended from the bar

and the top of the magazine entrance guides. Next be sure that the guides themselves are not bent out of place. They must all be equidistant and perfectly straight. To test them, use the stopping bar (*C*, Fig. 30) as a guide. Press it to the right, and if any of the partitions are bent out of place the projections on the stopping bar will cause the partitions to move, and they can be detected and straightened. See that the partitions lay close to these projections and that the lower end of the guides are bent so as to cause the matrices to enter the magazine without striking it.

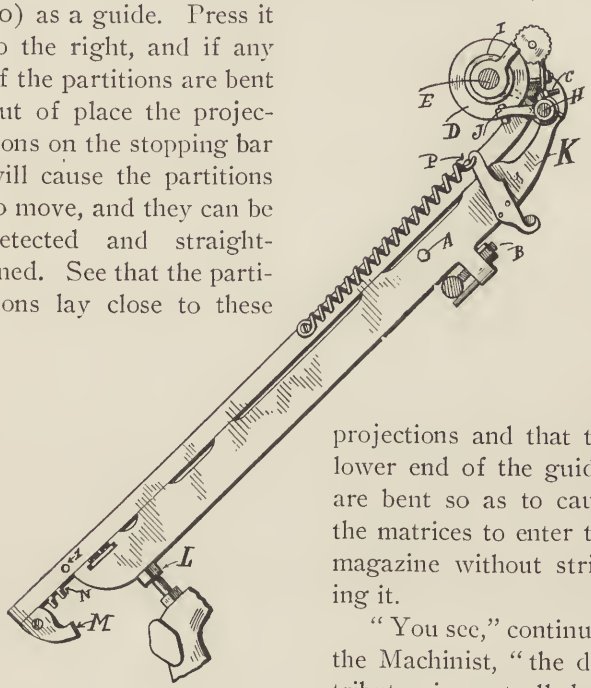



FIG. 29.

"You see," continued the Machinist, "the distributor is controlled by a friction clutch which slips if anything binds the distributor screws or matrix lift, thus preventing breaking or bending of the parts. The clutch is formed by a spring pressing a disk against the side face of the pulley (*D*, Fig. 29). The friction shaft (*E*) is geared to the distributor screws

and the gears are matched so as to cause the matrices to hang perpendicularly from the distributor bar. The back distributor screw (*F*) can be raised and swung upward by unlatching the catch on the right-hand end. Do not attempt to raise it, however, while there are matrices on the bar, and when closing it down see that the pin on the gear matches with the short tooth on the other gear, or else the distributor will not run. Watch the matrix-lift lever also and move it out of the way when closing down the back distributor screw."

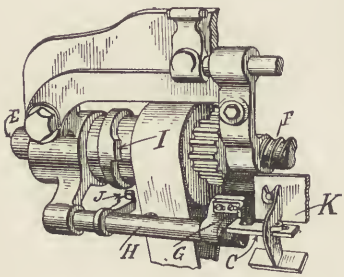


FIG. 30.

"The automatic stopping bar (*C*) is what throws the distributor clutch out of action, isn't it?" remarked the Operator.

"Yes," replied the Machinist; "the end of the bar rests on the end of the trip lever (*H*), and if matrices should clog in the guides the movement of the distributor bends the guides to the left, thus moving the stopping bar (*C*) and causing the end to slip off the trip lever. The small plate (*G*) on which the automatic stopping bar rests is adjustable, and should be set so that the bar (*C*) rests on it about 1-16 of an inch.

"I'll show you," continued the Machinist, "how the movement of the trip lever (*H*) throws off the clutch. Do you see that cam-shaped collar (*I*) on the clutch shaft? The clutch throw-off (*J*) stands directly below

and to the right of this collar, and is prevented from rising into the path of the collar by the stopping bar (*C*) resting on the end of the lever (*H*). When the stopping bar is pushed to the left, or the magazine entrance (*K*) is opened, the lever is allowed to rise, and it strikes against the side face of the collar, thus pressing the friction disk away from the pulley and allowing the friction to slip, and the distributor stops."

"What makes the distributor stop so that it has to be backed up before it will start again?" the Operator asked.

"Sometimes a matrix will get caught on the lift (*I*, Fig. 28), and then you will have to slip the distributor belt off the lower pulley and back up the distributor by turning the friction shaft (*E*) toward you until the lift (*I*) is lowered, when it will usually run again when the belt is thrown on."

"Is that all the adjustment there is for the magazine," asked the Operator.

"No," replied the Machinist; "the front end of the magazine must be adjusted to the proper height to permit the full stroke of the matrix escapements. Throw off the keyboard belts and touch the lower-case *c* and em-dash keys. Then turn the rollers by hand until the keyrods rise to their highest stroke. At this point there should be a clearance of 1-32 of an inch between the verge and the hook on the keyrod. Adjust by means of the screws (*L*, Fig. 29) under the magazine until this clearance is obtained."

"If the keyrods do not rest squarely on the verges, how do you fix that?" queried the Operator.

"The upper rod guide can be adjusted sidewise by

removing the brass guide block (*M*) on the magazine and either inserting a thin strip between it and the magazine or by filing the casting enough to cause the rods to center fully on the verges."

"I suppose it is quite a difficult thing to take out a verge if it should get broken," said the Operator.

"No," replied the Machinist; "like everything else, it is easy when you know how. If it becomes necessary to replace a verge, lock the magazine and keyboard, being sure to place the verge lock *above* the shoulder on the back pawl (*N*), and remove the magazine from the machine and place it bottom side up on the bench. With the pliers straighten the bent ears which hold the narrow brass locking strip in place and raise the strip to a point beyond the broken verge. Then with a rod of equal diameter to the rod on which the verges are pivoted, push out the latter until the desired verge is reached, when, if you separate the ends of the two rods a little, you can remove the verge and its pawls without disturbing the others. See that the pawls work freely in the verge, and if not, dress them a little with a fine file.

"Here's another pointer. The next time the pi channel in the magazine clogs with matrices, don't try to force them through with the matrix hook. You can remove the tube entrance by loosening the two screws underneath the magazine which hold it in place, and the pi will then come through. Straighten the brass tongue and see that it lies directly in the channel when replacing.

"That's about all I can tell you; the rest you will have to learn by experience. Don't get the idea that

you know it all. I learn something new nearly every day about this machine. Whenever you find a better or easier way of doing a thing, don't hesitate to adopt it. Handle the machine gently; never force it; keep it cleaned and oiled; attend promptly to repairs and adjustments, and you will find that the Linotype, instead of being the incomprehensible or refractory machine some have found it, will really prove a most tractable servant, and make the work of caring for its wonderful mechanism a real pleasure. Next month we are going to add a new machine to our plant, and then you will have a chance to learn how to erect and put a machine into operation."

## CHAPTER XVIII.

### ERECTING A NEW MACHINE.

THE new machine at last had arrived. When the four boxes were unloaded from the dray, the Machinist had rollers ready, and the large box containing the base and heavy parts assembled was slid upon the rollers and rolled into the building, the smaller boxes being trucked in. The large box was first attacked, the top taken off and the distributor bracket and the step casting unbolted and lifted out, when the front of the box was removed and the lag-screws holding the uprights to the skids taken out, the Machinist meanwhile removing the small braces inside the box, which could now be gotten at. The remaining three sides of the box were then lifted bodily back and the machine base left free, standing on the skids.

The machine was then rolled into its place on the floor and the skids withdrawn from beneath, the middle one first, the distributor step being the first part put on the machine to assemble it. The distributor bracket was now bolted in place, and the long, narrow box opened and the distributor taken out, and, after cutting the wires, it was bolted in place by means of the two tap screws inserted from the front of the bracket.

The Operator was then told to remove the wiring

which tied the various levers together. The Machinist then backed the machine by turning the clutch until the second-elevator lever ascended, when the vise was unwired, and, the square box being opened, the vise-locking screws were put in, the one numbered 1 in the hole numbered to correspond, being screwed in until the shoulder of the lock was flush with the face of the socket in the vise casting, the stops, which were first unscrewed and taken out, being then replaced. The intermediate bracket and shaft which is driven by the belt from the main machine pulley was taken from the square box and bolted in place, and then the upper key-rod guide and channel-plate support was taken out and placed in position, the small collar attached to the former being first slipped over that end of the shaft to which it was tied, and the other end placed in the seat in the support, which latter was then bolted to the intermediate bracket from beneath, the socket wrenches being used to tighten all these tap screws. The key-board was then taken from the box and the strings cut away, the two screws which held the keyboard in the box being used to fasten it to the machine frame from beneath. The keyrods were next unpacked and laid out on the bench in numerical order, when the Machinist said:

"Now you can place these keyrods in position while I unpack the rest of the parts. Begin with the lower-case *e* rod, No. 1. Place the hooked end of the rod through the upper guide from beneath, the hook toward you as you stand in front of the keyboard, and drop the lower end of the rod into the first slot in the lower rod guide. Be sure to get the first rod in the right

place, and then put the other ninety in the same order. The last and shortest one is the spaceband keyrod, and you can lay it aside temporarily. Here is a package of springs, which you can attach to the rods and the keyboard frame, front and back, when you have the rods in place."

While the Operator was engaged in connecting the keyrods, the Machinist put the second elevator in place and hooked the steel spring to it, put the distributor box in its place and then turned the machine back until the second elevator rose to its seat and the machine came into normal position. The distributor-shifter slide and lever were next assembled and the spring which operates the shifter lever attached to the machine frame. The burner was placed under the pot and then the Machinist unpacked the remaining box and removed the magazine and face plate. The magazine was carefully brushed out, and as soon as the Operator had finished the placing of the keyrods they lifted the face plate to its position, guided by the dowel pins with which it is fitted, and fastened it by means of the large flat-head tap screw in the intermediate spaceband channel, the smaller one near the right-hand vise-locking screw, and the remaining screw in the extreme right-hand end of the casting, putting the sort-tray bracket in place before this screw was put in, as the tap screw holds this bracket also.

The line-delivery pump was then screwed in place and the spaceband lever fastened to back of face plate, the screws being placed in from the front, the flat end of the lever being placed *beneath* the screw of the spaceband-box pawl lever (*E*, Fig. 15), and the other

end connected to the keyrod, which the Operator held in readiness. The piston rod in the line-delivery pump was then pushed into the cylinder as far as it would go, and the line-delivery carriage fastened to the end of the rod by means of the shoulder screw in the carriage, the same screw also serving to fasten the carriage itself to the link, which in turn connects the carriage to the line-delivery lever.

The second-elevator transfer carriage (Fig. 26) was next placed in its track and connected to the lever. Then the governor was fastened in an upright position and connected with ⅜-inch rubber hose as shown in Fig. 6.

The first elevator was next taken from the box, and after loosening the left-hand guide-blocks the elevator was put in place and the blocks adjusted to allow free movement of the elevator, but close enough to take up all play. The adjusting link in the bottom of the elevator was then connected to the lever, the flat spring on the barrel being turned outward. The vise being closed, the elevator was adjusted by turning the barrel until the grooves in the elevator were on a line with the grooves in the line-delivery channel.

The assembling elevator lever was next slid into the journals of the keyboard, the short coil spring being first slipped on the shaft, and the lever handle fastened to the shaft by the taper pin, the lever being screwed to the assembler block. The pi-box tube, matrix tray and copy-holder were fastened to the machine and the copy hooks screwed into the keyboard frame. Then the Machinist brought out the flexible front and placed it on the brackets which support it, the split guides being

made to straddle the rigid ones in the face plate; then the short chain was connected to hold the flexible front in its forward position. The large front glass was put in place and also the small assembler glass.

The back entrance was then fastened to the magazine and the spring (*P*, Fig. 29) attached to it to hold it closed, after which the magazine was placed in position in the machine and the flexible front depressed beneath the mouth of the channel.

The keyrods were connected to the verges as shown in Fig. 11, and verges and keyboard unlocked. The keyboard roller belts were connected, as also the distributor belt, and the belt on the intermediate shaft to the main machine pulley, the front keyboard roller and distributor belts being crossed, the latter so that it tended to run away from the distributor gears.

The Machinist and the Operator put in the rest of the day oiling, wiping and cleaning the new machine, and after running in the matrices and cleaning the spacebands, the Machinist tested the machine by turning it over by hand to see that all was in working order.

## CHAPTER XIX.

### TWO-LETTER ATTACHMENT.

"I SUPPOSE you have noticed," said the Machinist to the Operator, "that there are a number of improvements on the new machine. This being a two-letter machine, there are several new features on it you have not seen before."

"Yes," the Operator responded, "I was just examining the assembler. What are these levers (*D*, Fig. 31) for?"

"Look at the matrix first. You see each matrix bears two characters (Fig. 32), the roman letter in the usual position and the same letter in italic below it. The small-caps. are doubled up with the figures, and the italic figures made to run as side sorts in the pi box. The lever (*D*) in the assembler is attached to a plate (*C*) which works in a slot in the assembler and projects inside the box when the lower end of the lever is drawn forward. This plate then supports the matrices at a higher level than ordinarily so as to bring the italic faces in line with the roman faces of such words as are to be set in roman. The plate is in two sections, the right-hand end being a short piece having a shift-key (*F*) of its own. This is so that after setting the italic or small-cap. word, that portion of the plate can

be retracted, and the succeeding portion of the line assembled in the ordinary manner so as to produce the roman face, the plate (*C*) sustaining the italic matrices in their elevated position."

"Then there must be double grooves in the elevator and mold to hold those matrices while the line is being cast," commented the Operator.

"Exactly," replied the Machinist. "Also in the line-delivery channel. The first elevator has a similar

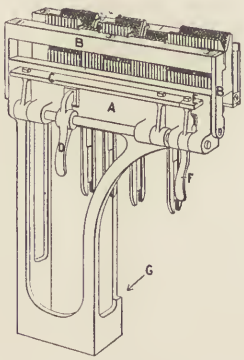



FIG. 31.

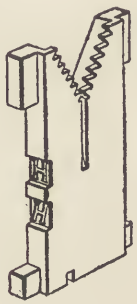


FIG. 32.

plate to sustain the matrices, and this plate is automatically retracted when the elevator rises to the elevator cap just before the line is shifted onto the second elevator, so as to bring the whole matrix line to a common level. The mold is equipped with two grooves for the lower ears of the matrices (*D, E,* Fig. 33), so that both roman and italic letters may be properly aligned. If you wish to recast a line bearing italic or small-caps., this small block attached to the bottom of the first-

elevator guide must be swung around so the first elevator can not rise to its full height, and so prevents the raised matrices from being restored to normal position.

"Nearly every batch of machines turned out from the factory has minor changes of parts, as the work of development proceeds. Improvements are going on

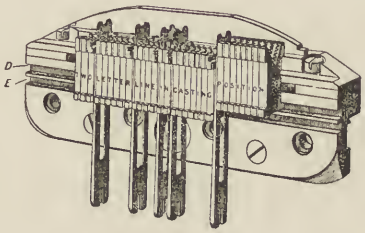



FIG. 33.

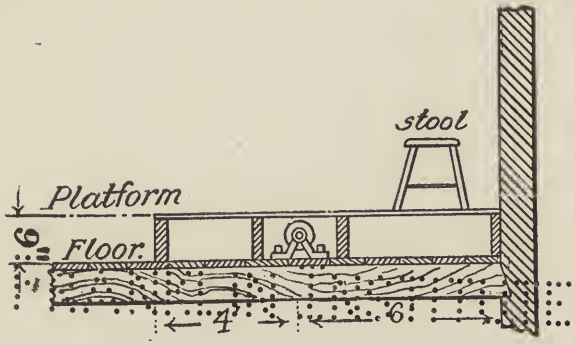
constantly. Two-letter matrices having combinations of black-face and modern instead of italic are made, and pica matrices is the latest innovation. These latter require an enlarged magazine to accommodate them. Probably the next step will be to produce tabular work that will permit the use of brass column rules."

## CHAPTER XX.

### PLANS FOR INSTALLING.

LINOTYPES should be placed where there is plenty of light and on a floor having as little vibration as possible. The machines should be leveled and the source of power should give a steady, uniform speed of rotation. Each machine requires one-fourth of a horse-power, but an allowance somewhat in excess of this should be given to insure steadiness. If motive power is to be derived from shafting, a countershaft should be placed on the floor and the machine driven from this, as overhead belting carries considerable dirt into the machine. The size of pulleys should be so calculated as to drive the machine pulley not less than sixty-two revolutions a minute and not more than seventy. The diameter of the machine pulley is 14½ inches. If countershaft runs 1,000 revolutions a minute, a 9-inch pulley would drive machine 62 revolutions. If countershaft runs slower, a larger pulley is required; if faster, a smaller one. To calculate the size of pulley necessary, multiply speed desired by size of machine pulley, and divide by speed of countershaft. The machine pulley must run with an "underthrow"; that is, must revolve, to one facing it, from left to right, or clockwise.

If individual motor is attached to the machine, which is the preferred practice, no arrangements are necessary for shafting or belting, as the motor is geared directly to the machine and the wires can be connected to the ordinary incandescent lamp circuit. Motors are wound for either 115 or 220 volts continuous current. They are ½ horse-power, but consume a current representing less than ¼ horse-power. The machine is




PLAN. I.—VERTICAL CROSS-SECTION OF PLATFORM.

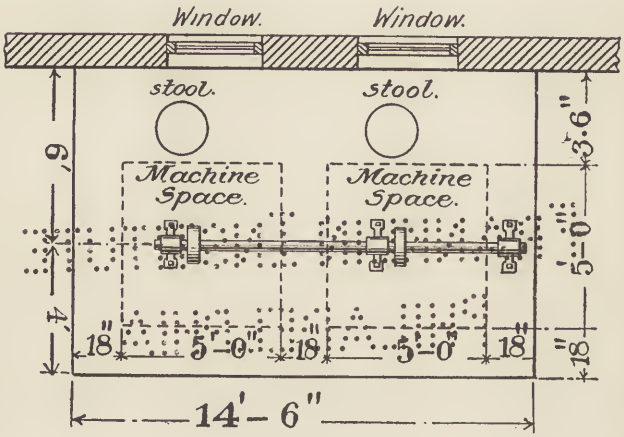
equipped with a bracket and removable socket for electric light in front of the operator. In addition to this, a light should be dropped behind the distributor for occasional use. In wiring motors for the Linotype place the wiring so that it will not interfere with changing of the magazine.

Sheet zinc or sheet iron should be placed on the floor under the machines.

Gas piping should preferably be brought up from the floor, though it may drop from ceiling to within about five feet from the floor and end with a cock and rubber-hose nipple. The main gas pipe should be

½-inch for one machine, ¾-inch for two, and ¼ inch larger for each additional machine, a 2-inch pipe being sufficiently large for twelve machines. A ½-inch pipe should be run to each machine. About a yard of ⅜-inch rubber hose is needed to connect the governor to the burner, and another piece about one foot long to establish connection with supply pipe.

The burner under the metal-pot will consume from thirteen to fifteen feet of gas per hour. Either illumi-




PLAN NO. 1.

nating or natural gas may be used. Oil burners will be supplied by the Mergenthaler Company without extra charge where gas can not be obtained. The gas at the burners should not exceed three-quarters of an inch water pressure. A pressure-governor is sent with each plant. Attach it as indicated by Fig. 5.

Plan No. 1 shows a preferred mode of erecting the

machine. The machine stands on a platform or false floor 9 inches above the main floor, and the driving shaft is mounted in boxes or bearings bolted to the floor under the platform. The belt extends upward to the machine pulley. A removable section in the platform gives access to the bearings and pulleys. The platform may be constructed by placing ordinary joists on the floor and laying flooring boards upon them. These platform joists are preferably laid crosswise of those in the building, so as to better distribute the weight. The machine weighs about 1,900 pounds.

The approximate cost of shafting, pulleys and platforms will be:

PLAN NO. I. — SINGLE MACHINE.

| | |
|---|---|
| 1 shaft, 5′ long, 1 15-16″ diameter, at 30 cents per foot | $ 1.50 |
| 1 6″ pulley, 4½″ face, 1 15-16″ bore | .85 |
| 2 pillow blocks, 4½″ high, 1 15-16″ bore, at $2.50 | 5.00 |
| 10 feet 2-inch single belting, at 14 cents per foot | 1.40 |
| 2 collars, 1 15-16″ bore, at 35 cents each | .70 |
| 80 square feet of platform, at 15 cents per square foot | 12.00 |
| Total | $21.45 |

*Labor not included.*

For each additional machine add the following material:

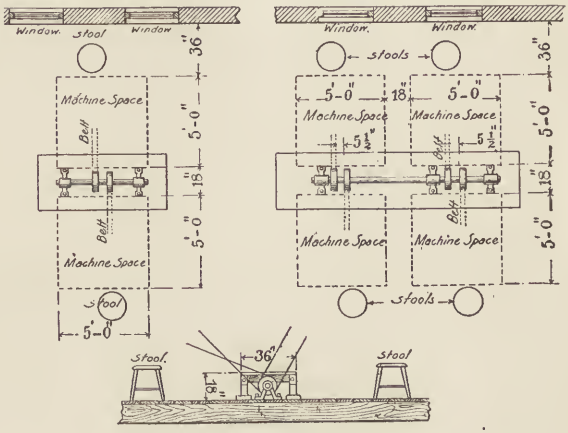
| | |
|---|---|
| 6′ 6″ of 1 15-16″ shafting, at 30 cents per foot | $ 1.95 |
| 1 6″ pulley, 4½″ face, 1 15-16″ bore | .85 |
| 1 pillow block, 4½″ high, 1 15-16″ bore | 2.50 |
| 10 feet 2-inch single belting, at 14 cents per foot | 1.40 |
| 65 square feet of platform, at 15 cents per square foot | 9.75 |
| Total per machine | $16.45 |

To this estimate add cost of pulley on main shaft and on countershaft and belting for connection between them.

FLOOR SPACE OCCUPIED.

Total distance from front to rear for machine or row of machines ..... 10′
Total width for single machine..... 8′
Total width for two machines..... 14′ 6″
Row of machines, side by side, allow in width for each. 6′ 8″

For large plants, machines may be arranged in two rows, back to back, directly on the floor, with a platform




PLAN NO. 2.

between the machines covering the shaft and pulleys. The single driving shaft is mounted in bearings on the floor between the machines. The platform facilitates changing of magazines, etc. The Mergenthaler Company supplies the standards to support the platform free of charge.

The approximate cost of installing under this plan would be:

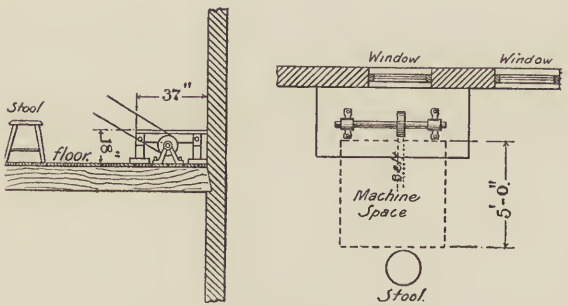
PLAN NO. 2.—TWO MACHINES.

| | |
|---|---|
| 1 shaft, 5′ long, 1 15-16″ diameter, at 30 cents per foot.. | $ 1.50 |
| 2 8″ pulleys, 4½″ face, 1 15-16″ bore, at $1.10 each..... | 2.20 |
| 2 pillow blocks, 10″ high, 1 15-16″ bore, at $3 each..... | 6.00 |
| 2 collars, 1 15-16″ bore, at 35 cents each..... | .70 |
| 20 feet 2-inch single belting, at 14 cents per foot..... | 2.80 |
| 18 square feet of platform, at 20 cents per square foot.. | 3.60 |
| 4 standards for platform (no charge). | |
| Total ..... | $16.80 |

For each additional two machines, add the following material:

| | |
|---|---|
| 6′ 6″ of 1 15-16″ shafting, at 30 cents per foot..... | $ 1.95 |
| 2 8″ pulleys, 4½″ face, 1 15-16″ bore, at $1.10 each.... | 2.20 |
| 1 pillow block, 10″ high, 1 15-16″ bore..... | 3.00 |
| 20 feet 2-inch single belting, at 14 cents per foot..... | 2.80 |
| 21 square feet of platform, at 20 cents per square foot.. | 4.20 |
| 2 standards for platform (no charge). | |
| Total for each additional two machines..... | $14.15 |

*Labor not included.*




PLAN NO. 3.

Another good plan, where the machines are placed in a single row, against a wall or otherwise, is shown in Plan No. 3.

The approximate cost of this arrangement would be:

PLAN NO. 3.—ONE MACHINE.

| | |
|---|---|
| 1 shaft, 5′ long, 1 15-16″ diameter, at 30 cents per foot | $ 1.50 |
| 2 pillow blocks, 10″ high, 1 15-16″ bore, at $3 each | 6.00 |
| 1 8″ pulley, 4½″ face, 1 15-16″ bore | 1.10 |
| 2 collars, 1 15-16″ bore, at 35 cents each | .70 |
| 10 feet 2-inch single belting, at 14 cents per foot | 1.40 |
| 18 square feet of platform, at 20 cents per square foot | 3.60 |
| 4 standards for platform (no charge). | |
| Total | $14.20 |

For each additional machine add the following material:

| | |
|---|---|
| 6′ 6″ of 1 15-16″ shafting, at 30 cents per foot | $ 1.95 |
| 1 8″ pulley, 4½″ face, 1 15-16″ bore | 1.10 |
| 1 pillow block, 10″ high, 1 15-16″ bore | 3.00 |
| 10 feet 2-inch single belting, at 14 cents per foot | 1.40 |
| 21 square feet of platform, at 20 cents per square foot | 4.20 |
| 2 standards for platform (no charge). | |
| Total per machine | $11.65 |

*Labor not included.*

The prices given will vary according to locality and trade conditions. The labor cost is not included for the same reason. The cost of gas pipe, electric wiring, etc., will also vary according to location, and is not included. In all cases where a shaft longer than sixteen feet is required, add one coupling at $4 for each 16-foot length, except the last length.

The following tools should be provided:

1 cold chisel, die stock and screws (assembled), 1 duplex burner, 1 lapping block, 1 right-angle screwdriver, 1 watchmaker's brush, 1 round brush, 1 foot each Stubbs' wire, 1-16, 3-32, 1-8, 5-32, 3-16, 7-32, 1-4, 5-16; 1 8-inch monkey wrench, 1 blow pipe, 1 each 8-32, 4-48 dies, 3 4-48 taps, 2 8-32 taps, 1 each 4, 5 and 6 inch screwdrivers, 1 bottle No. 120 emery, 5 sheets assorted emery cloth, 1 Stubbs' hand vise, 1 hand drill, 3 drills each 1-16, 3-32, 1-8, 5-32, 1 drill each 3-16, 7-32, 1-4,

5-16, 1 hacksaw frame and blades, 1 pair 6-inch snips, 1 6-ounce hammer, 1 belt punch, 1 set of broaches, 1 long-spout oiler, 1 small oiler, 1 pair keyboard pliers, 1 6-inch Bernard pliers, ½ dozen belt lacings, 1 micrometer, 1 bench vise, 1 soldering iron, 1 bottle soldering salts and solder.

Files: 1 6-inch No. 2 pillar, 1 6-inch No. 2 hand, 1 8-inch second cut, 1 6-inch round, 1 6-inch square, 1 12-inch flat bastard, 1 10-inch half-round second cut, 1 4-inch No. 0 Barrett, 1 4-inch No. 2 Barrett, 1 6-inch No. 0 Barrett, 1 6-inch No. 2 Barrett, 1 4-inch warding, 12 file handles.

The small extra parts, screws, springs, etc., together with the wrenches, gauges, etc., sent with initial instalments of machines, should be taken care of. Buy 8-32 and 4-48 screws by the gross. They cost no more that way than by the dozen. An empty type case makes a good receptacle for the various small parts. Have a place for everything and when through with a tool return it to its proper place.

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